Railway Engineering and Maintenance

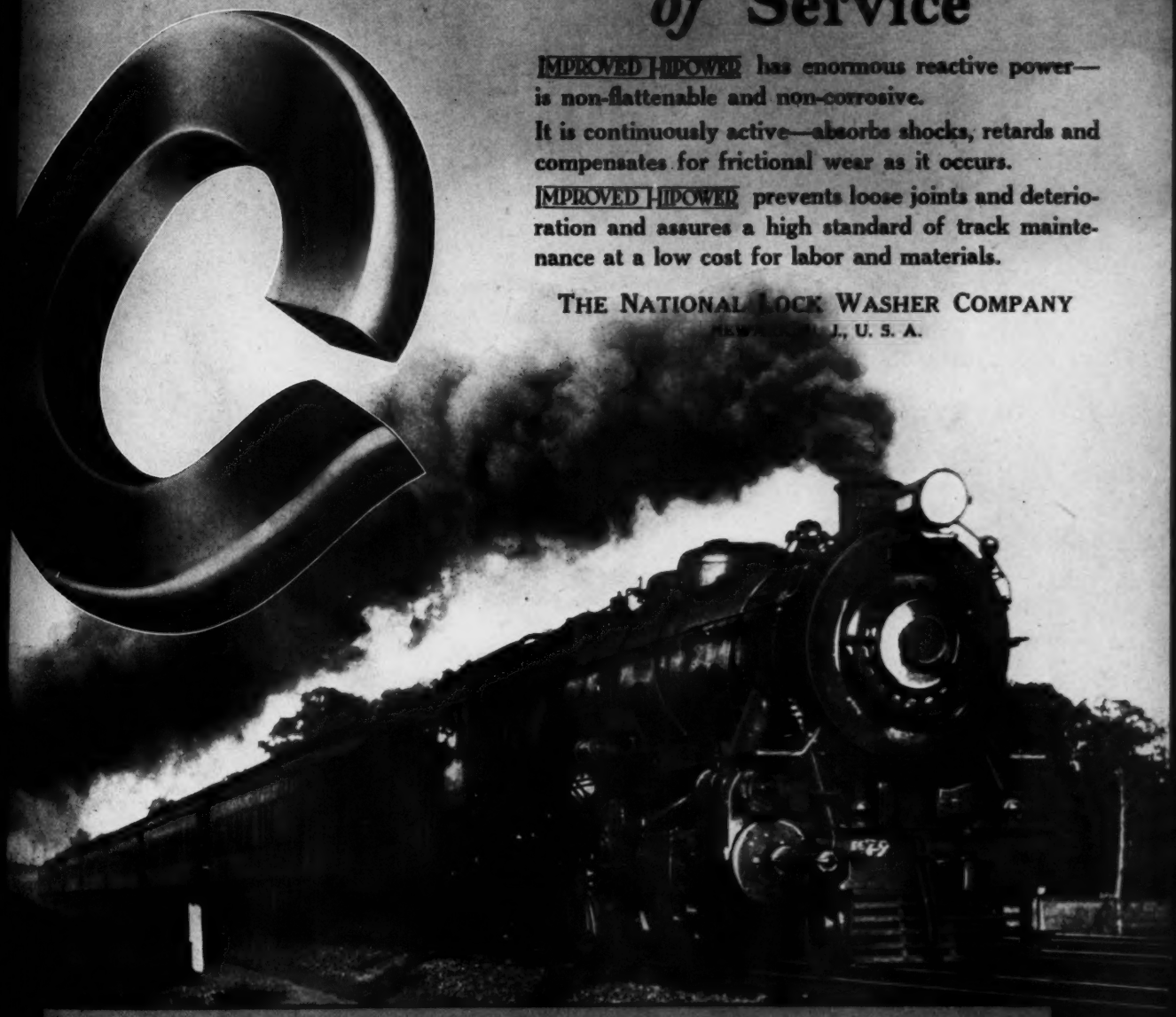
Extra Measure of Service

IMPROVED HIPOWER has enormous reactive power—is non-flattenable and non-corrosive.

It is continuously active—absorbs shocks, retards and compensates for frictional wear as it occurs.

IMPROVED HIPOWER prevents loose joints and deterioration and assures a high standard of track maintenance at a low cost for labor and materials.

THE NATIONAL LOCK WASHER COMPANY
NEWARK, N. J., U. S. A.



IMPROVED
HIPOWER
PARKERIZED

Tight Joints But Loose Rails

RAIL joints must be tight, but when a rail joint is so tight as to entirely eliminate free rail movement it becomes not only a dangerous joint but a costly one as a result of sheered off bolts, distorted angle bars and battered rail ends.

To keep a rail joint consistently tight and still permit freedom of rail movement requires a spring washer that possesses "just enough tension." This valuable feature is an outstanding Hy-Crome characteristic, developed through scientific heat treating processes following years of service tests to determine the greatest value to railroads in a spring washer.

HY-CROME

SPRING WASHERS

THE RELIANCE MFG. CO.
MASSILLON, OHIO

NEW YORK CLEVELAND DETROIT CHICAGO
ST. LOUIS SAN FRANCISCO
N. S. Kenney, Munsey Bldg., Baltimore, Md.
W. & A. C. Semple, Louisville, Ky.
Engineering Materials, Ltd., McGill Bldg., Montreal, Quebec, Canada

RAILWAY ENGINEERING AND MAINTENANCE
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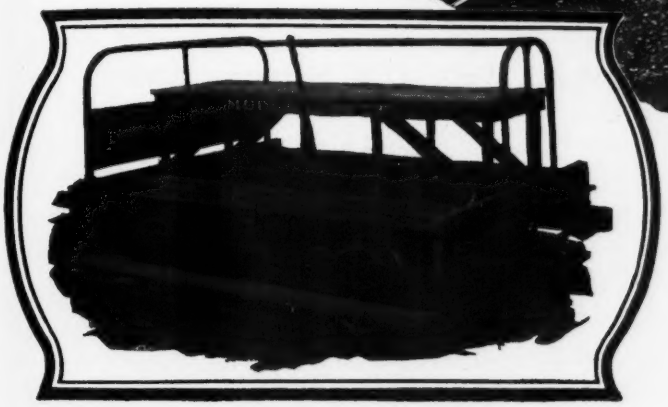
Alphabetical Index to Advertisers, Page 72 Classified Index to Advertisers, 68-70

To handle large gangs of men



The Mudge Trailer Car *Class T2*

TWENTY-FIVE men traveling in comfort on one Mudge Class T2 trailer car—that's what the picture shows. Roomy seats and full length foot boards make this possible. This car handles men with safety, too. A frame of carefully selected timber with ample braces and tie rods, special alloy steel axles, Mudge-Bower roller bearings which eliminate all axle cutting, cold pressed steel wheels with malleable iron hubs and adequate four-wheel brakes—these are a few of the special features.

This trailer not only meets the demand for comfort and safety in a car to handle large gangs, but it is noteworthy for its long life and low maintenance cost. Every frame member is of ample size to insure long life. The rugged assembly minimizes vibration. Undue strain on end sills is eliminated by the use of five tie rods and further by the famous Mudge spring drawbar. The 1 7/16" axles with new roller bearings carry heavier loads in safety than 1¾" axles fitted with old style bearings. The bearings are packed in grease when they leave the factory and require repacking only about once a year.

The Mudge Class T1 combination push car and trailer offers a trailer car of standard push car size with removable seat top which meets every requirement for a combination car to handle men and materials.

We manufacture a complete line of railway inspection cars and section cars, side drive or center load, direct connected or free running, air cooled or water cooled motors.

Consult Mudge for information on any motor car, push car, or trailer requirement.

Mudge & Company

Manufacturers—Railroad Equipment
Railway Exchange Bldg. • CHICAGO

CONTENTS

Volume 23 April, 1927 Number 4

Better Care of Treated Ties; R. S. Belcher 150
Plenty of Spring in This Pier Fender 156
Building a Second Track in Short Time; R. W. E. Bowler 159
How to Select Water Supplies 161
Are Foundations Under Crossings Worth While; O. F. Harting 163

Editorials 147
Are Your Ditches Open? 147
Why Early Strength Concrete? 147
Make a Record Now 147
An Objective Will Help 147
The Labor Shortage That Didn't Occur 148
The Superelevation of Curves 148
Curb the Respiking of Ties 148

New Books 149
Proceedings of the Roadmasters' and Maintenance of Way Association 149
Practical Structural Design 149

Other Feature Articles
Pipe Line Stops Slide in Cut 155
Foremen Receive Prizes for Safety Records 156
Further Reports on the Labor Supply 158
Getting Greater Early Strength in Concrete 168
Wages Increases for Maintenance Forces 169

What's the Answer 170
Track Liners for Main Line Sections 170
Should Heart Maple for Exterior Platforms Be Treated? 171
Depth of Ballast on Ballast Deck Bridges 171
The Effect of Pumps on the Maintenance of Pipe Lines 171
Flags or Metal Plates for Temporary Slow Signs? 172
Protecting the Tops of Cut Off Creosoted Piles 172
The Supervisor's Clerk 172
Keeping the Walls of Shops and Enginehouses White 174
Protection of Water Mains 174

New and Improved Devices 175
A Rail Laying Machine Which Will Also Raise or Shift Track 175
A Pneumatic Scaling Tool 176
A New Self Lowering Jack 176
Celite Makes Concrete More Workable 176

With the Associations 177

The Material Market 179

Railway News Briefly Told 180
Personal Mention 181
Construction News 184
Supply Trade News 186

294

Railway Engineering and Maintenance

Formerly the Railway Maintenance Engineer

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CONLEY SOLID MANGANESE
Self-Guarded
SPRING FROG

ENDURABLE
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EFFICIENT

Patented Oct. 21, 1924

Showing the Conley Solid Manganese Spring Frog in Service

Manufactured by

Conley Frog & Switch Co.
MEMPHIS, TENN.

SAVE 60% OF LABOR AND TOOL COSTS

WHAT ALL MAINTE-NANCE OFFICIALS WANT

TRY THEM ON TOUGH JOBS— THEY ALWAYS MAKE GOOD

Showing 3 Men Lining Track with 3 Hackmann Combination Track Liners
Saving Labor Cost of 4 or 5 Men
7 Men Can Do the Work of 15 or 20 Men

EFFICIENCY WITH ECONOMY

Now in use on over 100 railroads.

Results always far above expectations.

Labor costs cut in half.

Small and easy to handle. Weight only 20 lbs. Made of steel.

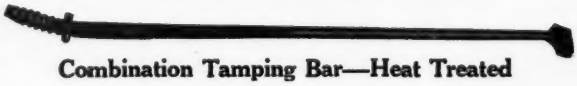
Lines track, frogs and switches.

Raises low joints and spaces ties.

Smooths rough track without disturbing road bed. Can be operated against the end of switch ties.

HACKMANN TRACK LINERS HAVE ALL THE ABOVE STERLING QUALITIES

Combination Lining Bar—Heat Treated



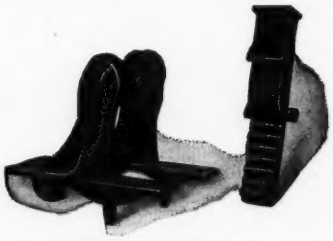
Combination Tamping Bar—Heat Treated

Hackmann Combination Track Liner

Hackmann Combination Track Liners are operated with the above special bar.

Hackmann Duplex Track Liners are operated with ordinary lining bar. Removable Fulcrum.

Note the Two Step Feature at top of base. You can make at least two pulls without resetting the liner. They can be left in track, allowing trains to pass over without any danger.



Hackmann Duplex Track Liner

WRITE FOR ILLUSTRATED AND DESCRIPTIVE LITERATURE

THE HACKMANN RAILWAY SUPPLY CO.

J. J. FRANZEN, *Secretary and Treasurer*

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for 120 more
Chicago & North Western Coaches

CHICAGO AND NORTH WESTERN LINE

... the Largest anti-friction journal order ever placed for suburban train service

Every year since 1923 the Chicago & North Western has been adding more and more Hyatt equipped rolling stock to its service and now, after four years of gratifying experience, has standardized on Hyatts for 120 new passenger coaches.

Uninterrupted bearing service through elimination of hot boxes—greater mileage at lower cost—smoother starts—quicker acceleration—worthwhile oil savings. All these Hyatt contributions have resulted in new measures of operating efficiency and economy.

All industry has depended largely on Hyatt's bearing building experience, its facilities and resources, during the last 36 years. You can inform yourself as to the exact advantages by consulting a Hyatt engineer.

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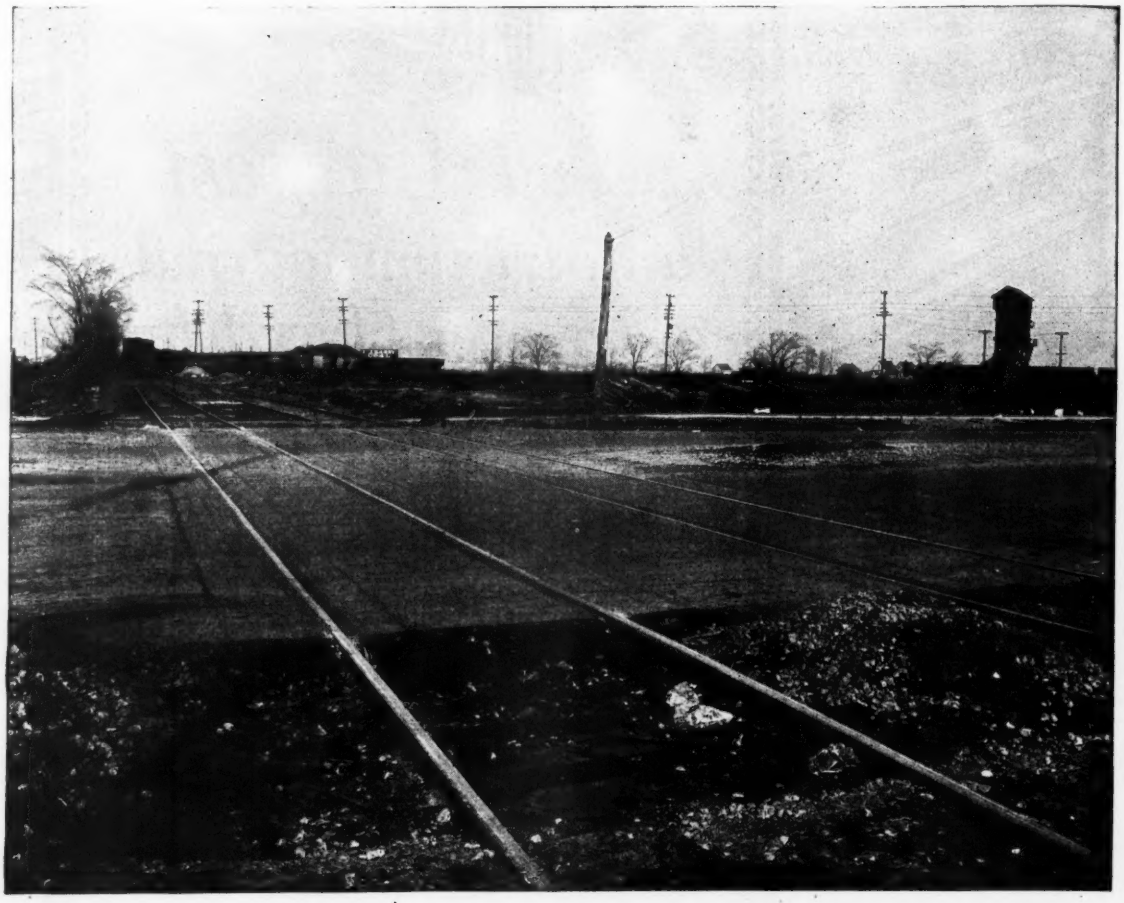
HYATT ROLLER BEARINGS

PRODUCT OF GENERAL MOTORS

HYATT Roller Bearings are successfully operating on about 50 different railroads throughout the country. A Chicago, Milwaukee and St. Paul car with Hyatts in the journal boxes has reached the total of 300,000 miles to date.

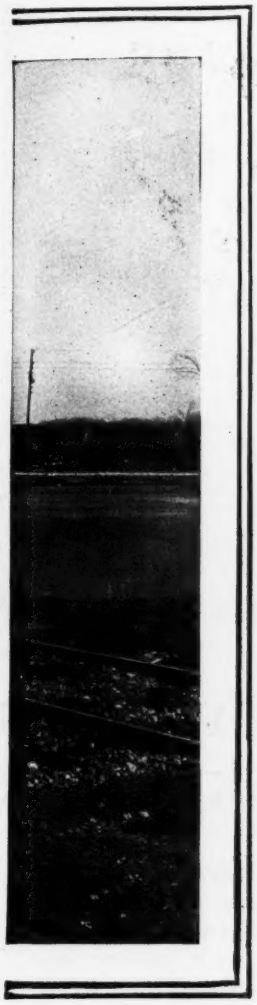
Hyatt boxes fit A. R. A. standard pedestals.

This modern crossing to time,



Detroit Terminal R. R. Crossing, *Warren Ave., Detroit, Michigan, installed December, 1926. Protected indefinitely against bad weather and traffic impact by Carey Elastite Preformed Track Pavement.*

won't yield traffic or temperature!



OLD Man Winter put up a valiant battle against the installation of this Detroit crossing. But his ten inches of snow and his half-inch of sleet failed utterly to halt the work. Winter's "weather war" was hopeless from the start.

In spite of the ease of installation, this modern crossing will last—yes, and improve, too—for years and years without the least bit of attention. For it's a crossing of Carey Elastite Preformed Track Pavement. Seventy-five of these Carey crossings have been installed in the last two years, from Maine to California. During that time they have been subjected to every conceivable kind of traffic and adverse weather—yet in not a single instance has a pick, shovel, or bar been required to keep these crossings in A-1 condition!

Carey Elastite Preformed Track Pavement eliminates holes and ruts along the rails. Its smooth, traffic-proof surface actually improves with time and travel. It is far safer, too, because motorists can look for trains instead of "passes" across the tracks. The sections of rail filler and the preformed, cut-to-fit slabs are easily and quickly installed in any weather. Write for full particulars about this improved grade crossing pavement.

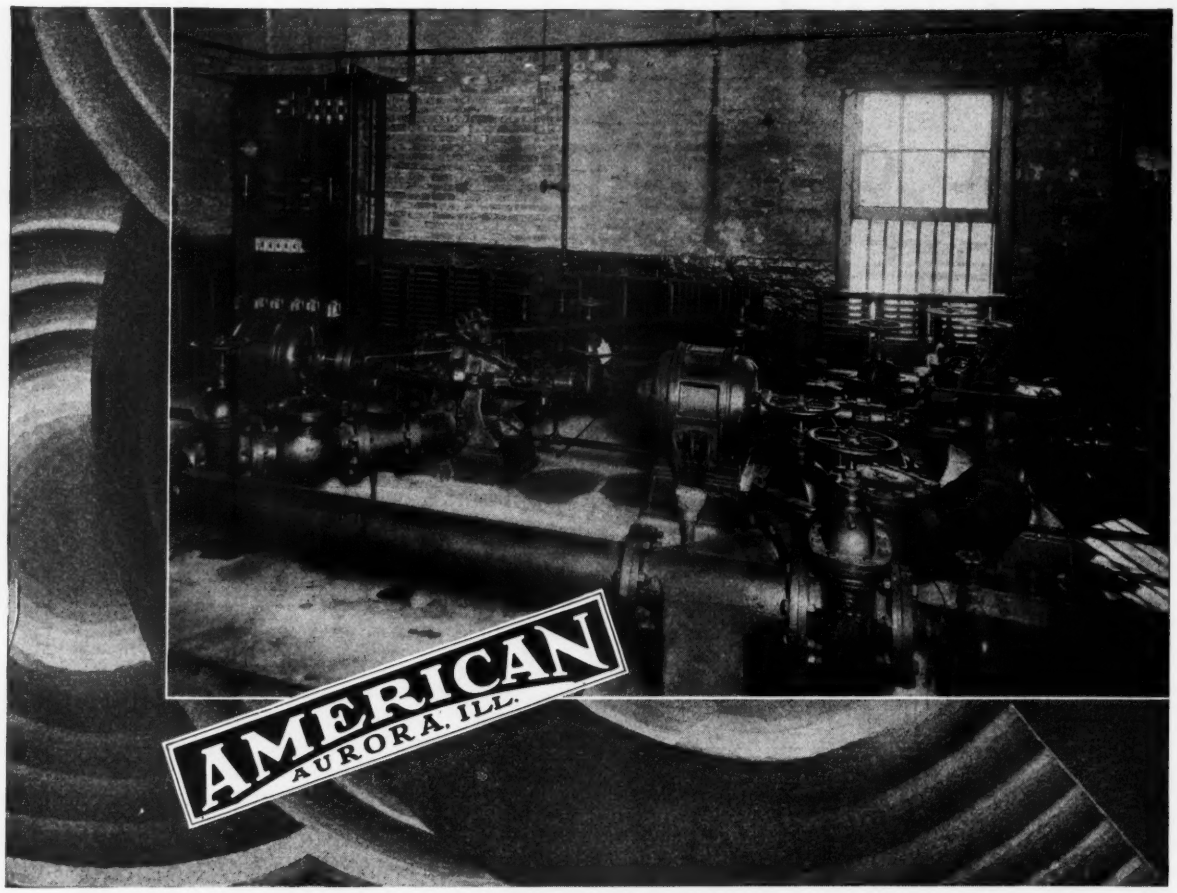
THE PHILIP CAREY CO.

Lockland, Cincinnati, Ohio

Carey Elastite

PREFORMED TRACK PAVEMENT

"Knits and heals under traffic"



Illinois Central Railroad Company's Pumping Station at Kankakee, Ill.

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420 E. Third St.

BACK in 1920 the Illinois Central Railroad Company installed the station pictured above at Kankakee, Illinois. This station consists of two 5″ double-suction "American" pumps equipped with bronze impellers and bronze fitted. Each pump delivers 600 G. P. M. against a total head of 105 feet when running at 1750 R. P. M. with an efficiency of 66%. Both of these pumps are driven by 25-H. P. direct-connected electric motors.

The whole station is automatically controlled and operated through a Sundh panel switchboard and an American diaphragm primer valve. The automatic control of water supply necessitates unusual dependability in the pump equipment used. "American" pumps were chosen for the purpose!

THE AMERICAN WELL WORKS

General Offices AURORA, ILLINOIS *and Factory*

Why we use Union Carbide

The railroad shops served by Oxweld Railroad Service are large users of acetylene. It is essential that the acetylene be supplied to the gas outlets in the shop at uniform pressure. For this purpose, Oxweld Railroad Service uses Union carbide—a product of national reputation for quality and uniformity. The carefully sized lumps of Union carbide permit the smooth evolution of gas in the generators.

The efficient use of this high quality fuel is the job of Oxweld Railroad Service. It involves expertness in the application of the oxy-acetylene process, a thorough familiarity with its possibilities in railroad work and ingenuity to adapt the technique to the special problems in a given railroad. It is a refinement possible only with a competent service.

THE OXWELD
RAILROAD SERVICE COMPANY

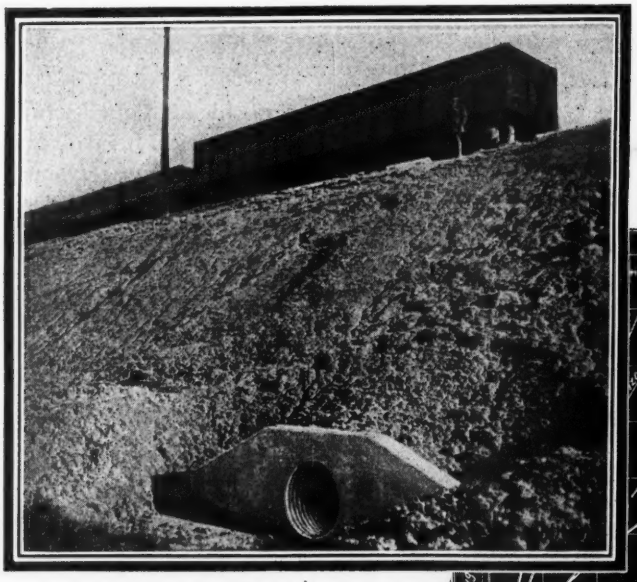
Unit of Union Carbide and Carbon Corporation

New York City: Carbide and Carbon Building
Chicago: Railway Exchange

Oxweld
Railroad Service

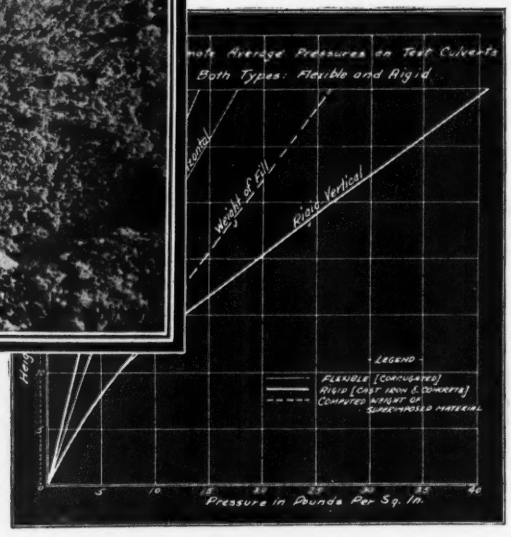
Let Armco's proven strength carry *your* traffic

Proved—



ARMCO Culverts are stronger because they change vertical loads to a practically even load over the entire circumference. This is why ARMCO Culverts endure under loads of fill and traffic that would crack and crush rigid materials.

—by time



—by test

TO avoid heavy upkeep expense culverts must have strength to resist both weight of fill and impact of traffic. Culverts are being buried away in the ground, out of sight, even forgotten. Yet road upkeep and maintenance depends on their effective operation for they are guardians of the road foundations.

So engineers are carefully investigating culvert materials to make certain they can endure the loads and strains of culvert service. Thousands of veteran ARMCO Culverts have proved ARMCO has this strength—some of them under fills up to eighty feet in depth and subject to the heaviest main line traffic loads. For a generation these pipes have been giving perfect service without breakage or other damage—without upkeep expense.

Now this tremendous strength in service is explained through an exhaustive test by the A. R. E. A. at Farina, Illinois. This test shows ARMCO Culverts are stronger because they distribute loads over the entire culvert circumference. They endure because they use *all of the strength of the culvert.*

Every engineer interested in culvert economy and durability (particularly in heavy load service) should have the facts developed by this test. They are yours for the asking.

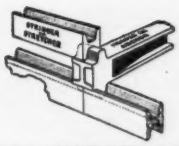
ARMCO CULVERT MANUFACTURERS' ASSOCIATION

MIDDLETOWN, OHIO

ARMCO CULVERTS

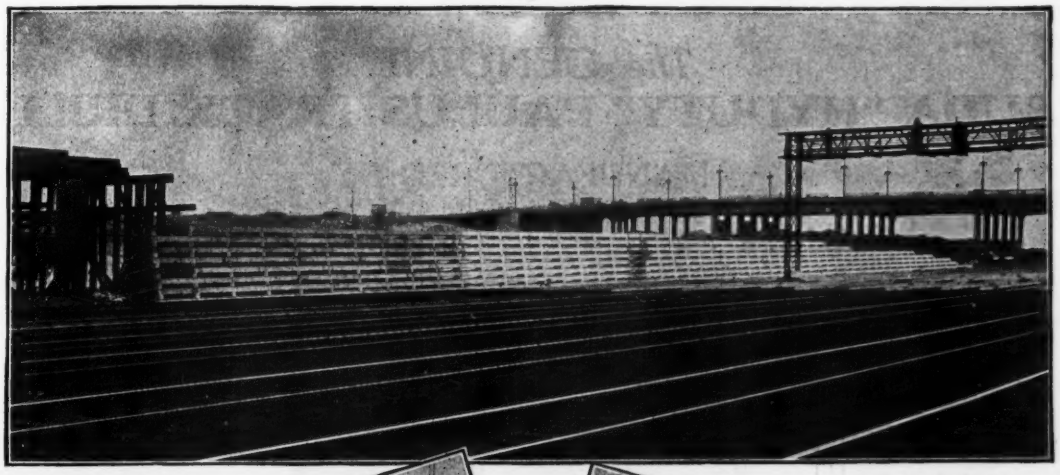
Predominant in use—because predominant in quality

R. C. RETAINING WALL UNITS

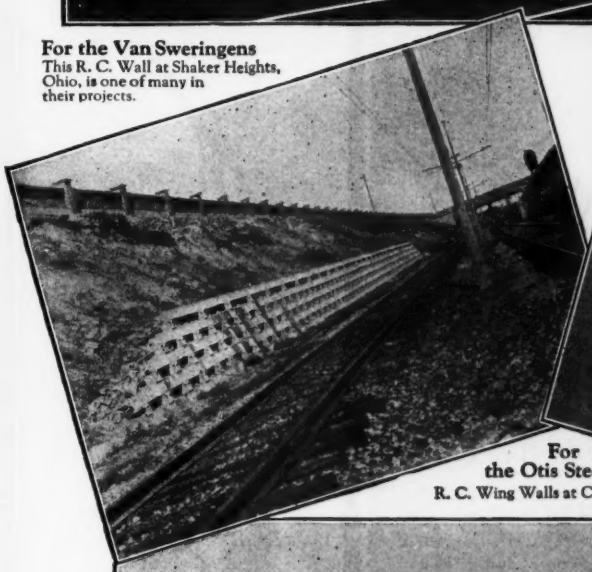


Usually Cut the Costs Over 50%

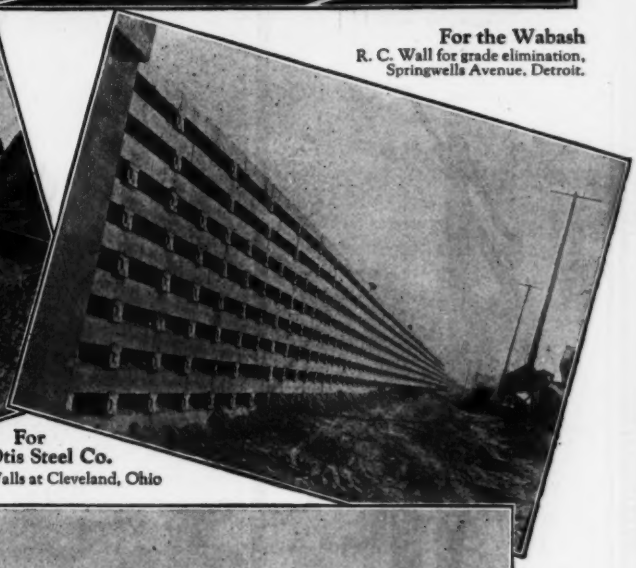
Because in building an R. C. Wall, such as that for the Illinois Central, shown below—no skilled labor, mason work or massive foundations are required.



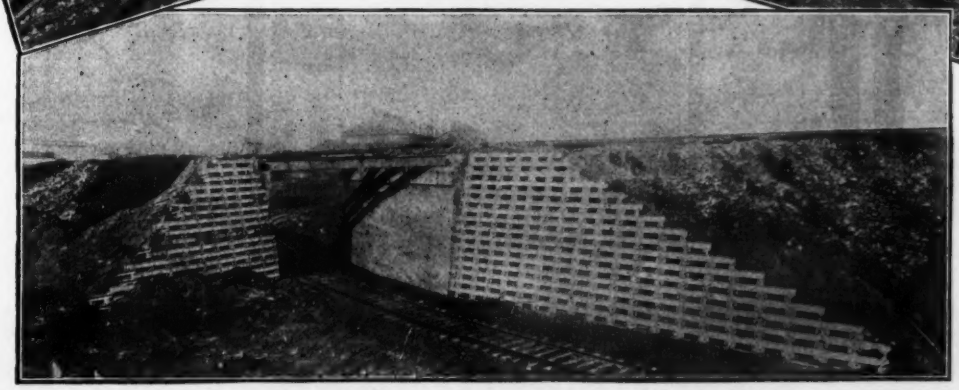
For the Van Sweringens
This R. C. Wall at Shaker Heights, Ohio, is one of many in their projects.



For the Wabash
R. C. Wall for grade elimination, Springwells Avenue, Detroit.



For the Otis Steel Co.
R. C. Wing Walls at Cleveland, Ohio



Send for this Free Book The R. C. Book contains illustrations of many typical installations—shows wall details and gives standard specifications. Also other useful information. Write or send the coupon for a copy—for present use or for your files.

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ENGINEERS BUILDING, CLEVELAND, OHIO
New York Chicago Norfolk Pittsburgh San Francisco
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PRECAST RETAINING WALL UNITS

The R. C. Products Co., Inc.
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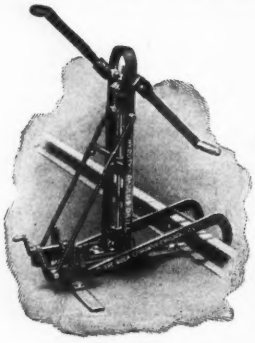
Send me your *free* book of Retaining Wall Data ☐
Also complete information on the use of R. C.
Units for the following purposes_____

*Company Name*_____
*Individual's Name*_____
*Address*_____

BUDA
ESTABLISHED 1881

The GENUINE
BUDA "HYDUTY" PAULUS TRACK DRILL

MANUFACTURED BY
THE BUDA CO. *ONLY*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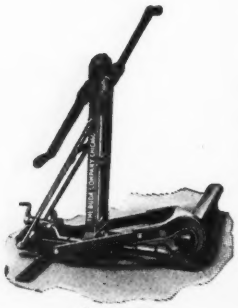
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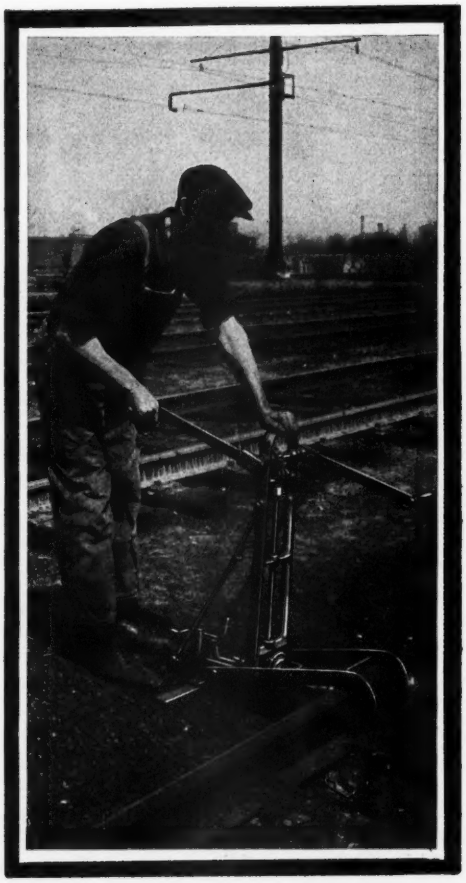
Buda-Wilson Bonding Drill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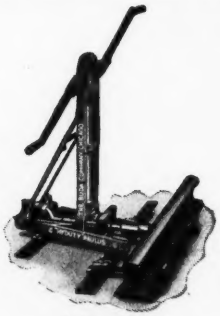
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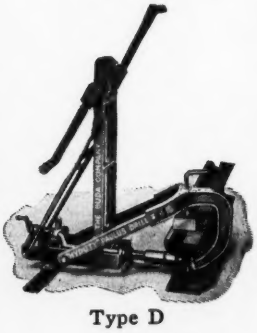
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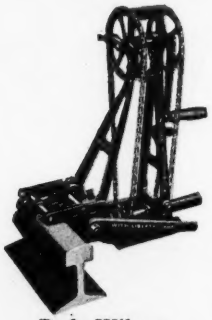
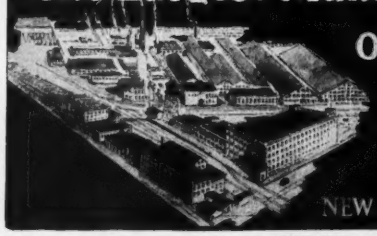

Buda-Wilson
Bonding Drill
with "Liberty" Clamp

The Largest Manufacturer of the Most Complete Line
of Railroad Materials and Track Supplies

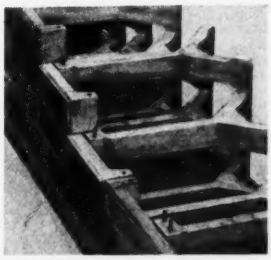


THE BUDA COMPANY
HARVEY (CHICAGO SUBURB) ILLINOIS
NEW YORK. CHICAGO. ST LOUIS. ATLANTA. SAN FRANCISCO. LONDON

This Cribbing costs less - does more

Many installations have proved these outstanding superiorities of Federal Concrete Cribbing units:

1. Only two units—no third member in the backfill.
2. Easier to install than any other type.
3. Low unit cost; low labor cost; no maintenance expense.
4. As good looking as fine masonry.
5. Permanent as a concrete wall yet can be easily relocated with practically 100 percent salvage.



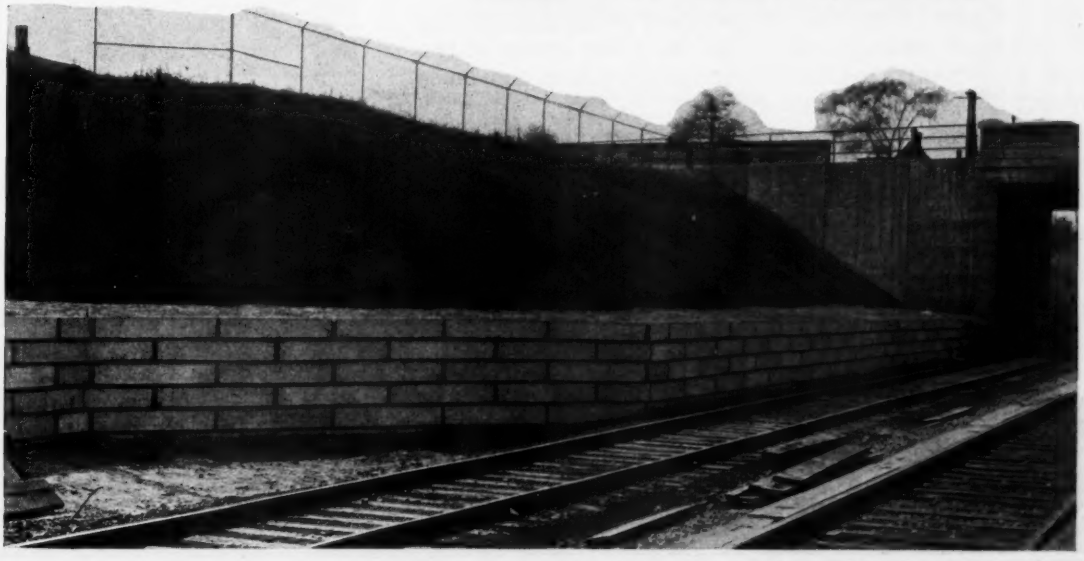
Note simple construction

Federal Concrete Cribbing employs only two units. The stretchers, or face members, interlock with the Y-shaped headers, forming a cellular wall without a third member in the bank. A one-inch continuous slot assures free drainage with no possibility of backfilled material filtering through.

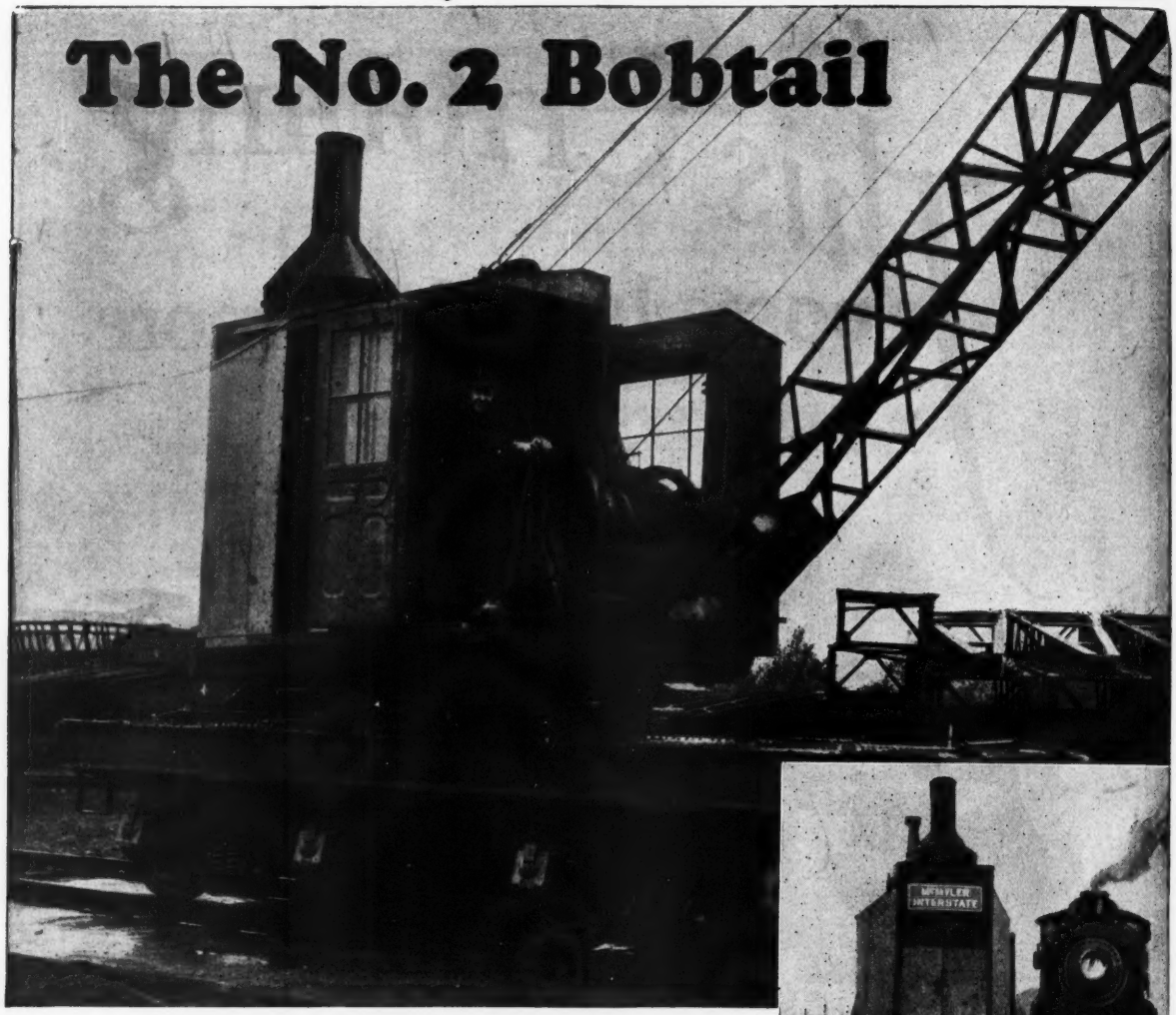
Ask for a list and photographs of installations for some of America's leading railroad systems.

FEDERAL CEMENT TILE CO.
608 S. Dearborn St., Chicago

FEDERAL CONCRETE CRIBBING



The No. 2 Bobtail

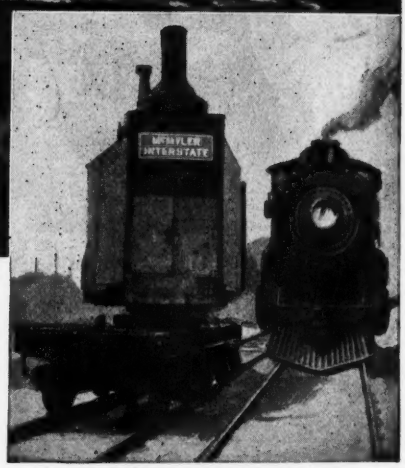


A Locomotive Crane Specially Designed to Meet Railroad Problems

—has a tapered turntable and positive swing-stop, giving it a maximum swing of only 5′ 8″ from the center of the track. This means that traffic on adjacent tracks continues without interruptions or slow-downs.

This safety factor coupled with the Bob-Tail's tested and admitted ability to out-dig and out-work standard cranes and railroad-ditchers gives it a predominant place in ditching, ballast-screening and general utility equipment.

See that your road investigates the Bob-Tail.



Full Speed Ahead— when the No. 2 Bob-Tail is working on adjacent tracks. The fool-proof positive swing-stop makes collisions impossible.

Steam Shovels • Gas Shovels • Locomotive Cranes • Clam-shell Buckets

C-2-145

McMyler-Interstate

NEW YORK BUFFALO PHILADELPHIA PITTSBURGH **CLEVELAND** DETROIT CHICAGO SAN FRANCISCO LOS ANGELES

JORDAN SPREADER

The Composite Spreader-Ditcher, which is the Jordan Spreader with the composite Spreader-Ditcher Attachment, performs all the functions of the Spreader (moves earth, spreads bulky materials, plows snow) and in addition will shape ballast and subgrade, form new ditches or clean old ones, and trim the banks of cuts to a uniform slope.

An all-year Machine. In use on North America's leading railroads.

Write for Copy of New Catalog

Shopping for horsepower-

—the job of every railroad purchasing agent

THE wise railroad man can *bring down* the cost of his horsepower! It is being done in hundreds of power plants and shops today.

You are a user of power and you can do it too —by shrewdly buying those materials which conserve coal and the power that coal generates.

Horsepower is cheaper because of Asbestos

Asbestos is one of the most important of power saving materials. It is made by Johns-Manville into packings, pipe and boiler insulations, refractory cements, and other products which guard and guide horsepower through to production in your power houses and on your motive power and rolling stock.

And saving horsepower is many times cheaper than creating it! A Johns-Manville Sales Engineer can quickly prove this to your advantage.

Through— Asbestos and its allied products: INSULATION, BRAKE LININGS, ROOFINGS, PACKINGS, CEMENTS, FIRE PREVENTION PRODUCTS

JOHNS-MANVILLE
Service to Railroads

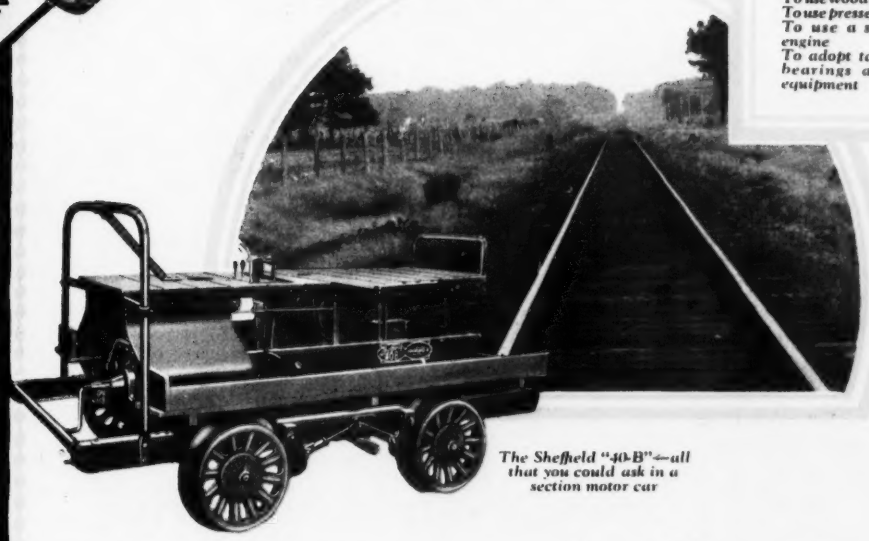
JOHNS-MANVILLE CORPORATION, Madison Ave. at 41st St., New York

BRANCHES IN ALL LARGE CITIES. For Canada: CANADIAN JOHNS-MANVILLE CO., Ltd., Toronto

TIMKEN EQUIPPED

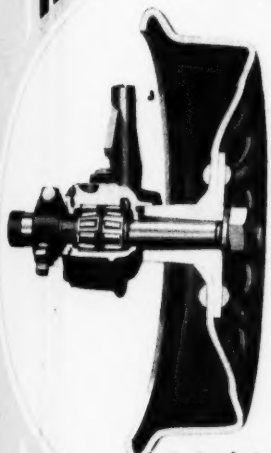
Fairbanks-Morse *was* FIRST

To build a center-load car
To use a water-cooled engine
To use a gear drive
To use a chain drive
To use a free-running engine
To use a clutch drive
To use a two-cycle engine
To use a pressed steel frame
To use wood center wheels
To use pressed steel wheels
To use a self-priming engine
To adopt tapered roller bearings as standard equipment



The Sheffield "40-B"—all that you could ask in a section motor car

The open road of leadership



Sectional view showing how axles of Sheffield cars are carried on Timken Bearings. Note the sturdy bearing-box, specially designed to provide additional strength

Someone must lead. In the section motor car field, Sheffield long ago assumed this responsibility. That Sheffield motor cars have kept faith in the onward march of improvement is well illustrated by the impressive list of Sheffield "firsts," above.

Fairbanks-Morse has constantly sought to *better* the Sheffield line with the definite purpose of raising the section motor car to a new plane of quality, dependability and operating economy. And the best evidence of F-M success is the present line of finer Sheffield cars.

Today the same progressive policy offers to section motor car users still another improvement—Timken Tapered Roller Bearings.

For the past two years this type of bearing has proved its value on the Sheffield "40-B," shown above. Now you can have other Sheffield models—*Timken-equipped!*

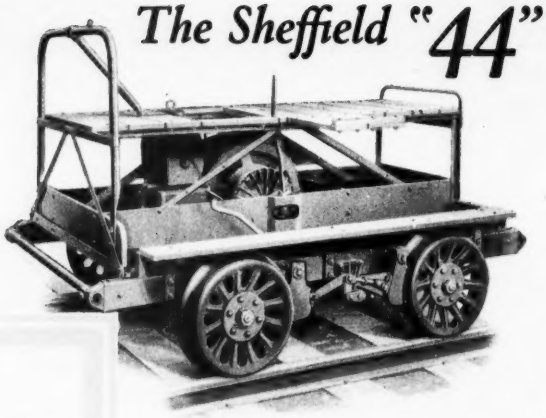
Write today for literature covering Sheffield betterments. Note important announcement on next page

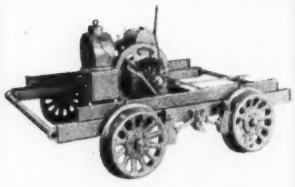
FAIRBANKS-MORSE
MOTOR CARS

First on the rails —and still first

TIMKEN EQUIPPED

The Sheffield "44"





Entire body, seat and deck lifted off after removing only four bolts—showing the "44's" non-burn-out clutch—one of the most revolutionary developments in recent motor car design

—perfected clutch chain drive

Velvety in action and positive when engaged! These are qualities of the Sheffield "44's" perfected drive that have won universal popularity wherever this sturdy motor car has seen service.

To the section car user, the Sheffield "44" brings a powerful one-cylinder, water-cooled car of wide utility—equipped with *positive* chain drive, and a clutch that can't be burned out. Slip the clutch as much as you want—without harm!

The "44," like other Sheffield models, has such advanced features as improved, high-efficiency engine remarkably low on fuel consumption—pressed-steel automobile type frame—complete accessibility throughout—Timken Tapered Roller Bearings—and other improvements.

No broken belts with this car! No sliding engine base; no tugging at a tension lever; no expensive delays while the gang stands idle. This simple, practically fool-proof section car sets an entirely new standard of motor car dependability and economy. Ask for detailed information.

NEW— Fairbanks-Morse announces push cars and motor car trailers of new and greatly improved design. The "4-B" push car for average service. The "12-B" for heavy duty. Timken bearing equipped. Write for complete information

FAIRBANKS, MORSE & CO., *Chicago*

Manufacturers of railway motor cars; section cars; push cars; velocipedes; stand pipes for water and oil; tank fixtures; oil engines; electric motors; steam, power and centrifugal pumps; scales; complete coaling stations

FAIRBANKS-MORSE
MOTOR CARS

First on the rails — and still first

ARA 21.20

Track Fastenings

IN ordering Track Fastenings, you can be sure of intelligent service, certain of a uniform product, positive of dependability, by entrusting your requirements to the Illinois Steel Company—schooled by long experience in the art of serving railroad needs; able because of its designing, manufacturing and inspection standards, to guarantee a consistently and permanently satisfactory business relationship. . . Our railroad engineers are at your service.

Illinois Steel Company
208 South La Salle Street
Chicago, Illinois

ILLINOIS
STEEL PRODUCTS
Carefully Inspected—Always Uniform

Less men~ Faster Progress!

Syntron Power Plant

Compact, light in weight and easy to handle, the portable Syntron Power Unit is ideal for use in heavy main line traffic where quick moves are often necessary.

This unit consists of a gas engine and a 110 volt A. C. generator. Runs automatically—requires absolutely no attention other than for gas, oil and water, automatically supplying the current for the Syntron Tie Tampers as well as any other portable electric tool used in maintenance work.

"Syntron-ize to Economize"

THE Syntron is the most efficient Tie Tamper ever devised and makes possible savings in railroad track maintenance never before realized.

Through the unique application of magnets energized by alternative current, the Syntron Tie Tamper strikes 1500 blows a minute making it possible for the four workmen shown above to do the work of twelve pick tampers.

Syntron not only triples the amount of track tamped per day, but also tamps a smoother and firmer roadbed that lasts two to three times as long as a hand tamped track.

From every standpoint the Syntron Tie Tamper is the ultimate development in practical and economical mechanical tie tampers.

Let us tell you more about it.

THE SYNTRON COMPANY

LEXINGTON AVENUE · PITTSBURGH, PA.

The Greatest Advantage and the Greatest Economy

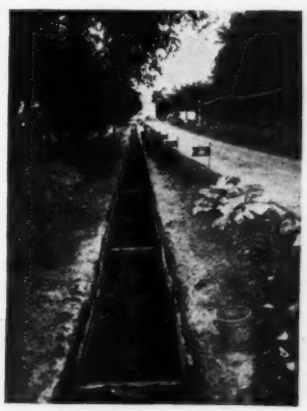
"Any practice, custom or method of consumption that tends to substitute the temporary for the durable is wasteful and extravagant...They are vastly more detrimental to progress than many of the other forms of extravagance to which our attention is frequently called."

THESE words, originally printed in the publication of a banking institution, were lately reprinted in a bulletin of the Department of Commerce, U. S. A.

In them are found the greatest reason for the use of Cast Iron Pipe.

It Is Permanent

The actual limits of its working life under average conditions are as yet undetermined. It will take the tests of additional centuries to determine how long Cast Iron Pipe will resist corrosion. No case has ever come to light where Cast Iron Pipe wore out under average service conditions.



A waterworks must be built for permanence. It serves the people in their settled abode. It is a service upon which they depend.

The Waterworks Engineer can depend upon Cast Iron Pipe.

A well made, properly laid water main of Cast Iron Pipe can be safely put under pavement with assurance that, barring accident, it will function for hundreds of years.

Population is bound to increase to the point where larger mains are needed. Cast Iron Pipe in the present mains can be taken up, and relaid with the assurance that it will be good for hundreds of years to come.

The service of this Bureau is always available on any plan involving the use of Cast Iron Pipe.

Address: RESEARCH ENGINEER
THE CAST IRON PIPE PUBLICITY BUREAU, PEOPLES GAS BUILDING, CHICAGO

CAST IRON PIPE

Our new booklet, "Planning a Waterworks System," which covers the problem of water for the small town, will be sent on request

Send for booklet, "Cast Iron Pipe for Industrial Service," showing interesting installations to meet special problems

The Kind of Service Fairmont Insists Upon

A Foreman Car Inspector and two men are now taking care of 50 miles of very busy main line and 25 miles of branch with a covered M2 Fairmont car like that shown below.

Rain or shine, at all hours of the day or night they go shooting back and forth, keeping out of the way of traffic and quickly making light repairs and fixing hot boxes.

It is worth real money to get cars of perishable freight moving again soon after they are set out for repair. No matter what out-of-the-way place cars are dropped, this foreman gets there in a hurry with his two helpers and half a ton of jacks and tools.

He gets 30 miles per gallon of gasoline and his Fairmont car has already run twice as long without overhauling as any other make used on this job.

Performance on the Job Counts

FAIRMONT RAILWAY MOTOR CARS

Inspection—M19

Light Section—M14

Section A2 M2 S2

FAIRMONT RAILWAY MOTORS, Inc.
Fairmont, Minnesota

District Sales Offices:
NEW YORK CHICAGO ST. LOUIS SAN FRANCISCO
WASHINGTON, D.C. NEW ORLEANS WINNIPEG, CANADA

BALDWIN LOCOMOTIVE WORKS
Foreign Representatives

More work and less effort with OLIVER AMES shovels

7 *Reasons For Using OLIVER AMES Shovels*

1. The OLIVER AMES Bend—the perfect shovel balance; often copied, never duplicated.
2. Blade of heat-treated alloy steel with maximum resistance to wear.
3. Finest craftsmanship, as details of finish readily prove.
4. Lightest weight construction consistent with strength.
5. Best handle known, genuine Northern Ash, second growth.
6. All Dee-Handles, supplied in OLIVER AMES Split Dee, I-D-L, Sturd-E, Wright Metal or Wooden Dee.
7. Distributed by best dealers throughout the world.

Whether it's ballast, sand, cinders, or gravel, OLIVER AMES Shovels are the hand tools that can handle it day after day with a minimum of effort.

The famous OLIVER AMES Bend in the handle, a perfected OLIVER AMES feature, permits the operator to fill his blade to capacity easier and more often.

OLIVER AMES Shovel blades are made from wear-resisting, special analysis alloy steel treated to withstand the most severe usage.

OLIVER AMES handles, made only from selected second-growth Northern Ash, are finished to a perfect balance.

The first cost of OLIVER AMES Shovels is not high, but the real economy is in their long life.

Write for Catalog showing all sizes and types

O. AMES SHOVELS

SHOVELS — SPADES — SCOOPS

At good supply houses everywhere

AMES SHOVEL AND TOOL COMPANY, Ames Bldg., Boston

Owner of Oliver Ames & Sons Corp., North Easton, Mass. Est. 1774

777

Railroad Men:

Starting Resistance Reduced 7/8ths

Far heavier trains can now be smoothly started with present motive power. Car journals equipped with Timken Tapered Roller Bearings make it possible by eliminating seven-eighths of the former starting resistance. Fuel and power are saved. Locomotives, draft gear, wheels, rails, and roadbed escape destructive starting effects.

The highly frictionless, perfectly enclosed Timken-equipped journals run for months between inspections, without hot box dangers.

Many other operating, maintenance, and depreciation charges are reduced by using Timken Bearings. That is why they loom as an inevitable railroad improvement. On the Chicago, Milwaukee and St. Paul, Timken economies are already being effected.

This entire subject has long had the benefit of Timken research and development. The resultant data, together with any desired engineering counsel, are at the disposal of every railroad. A request makes available all the talent responsible for the successful railroad anti-friction bearings.

THE TIMKEN ROLLER BEARING CO., CANTON, OHIO

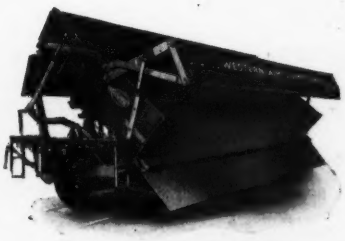
The Man on the Job Wants Westerns

If you happen to notice two makes of dump cars on the same piece of work, none of the Westerns will be idle. *The men on the job* use the Western in preference to all others because of its ease and speed in dumping to either side without previous preparation, clean dumping, and dependability.

These same qualities in the Western Air Dump Car equipped with aprons to throw the load well beyond the ballast line, are bringing Westerns to the fore as the ideal car for ditching.

At right — 20-yard Western Automatic Air Dump Cars with aprons at work on the El Paso and Southwestern Railroad. (Southern Pacific).

Our new 50th Anniversary Catalogue, shown below, explains these cars in detail. Write for your copy at once.



The Western Automatic Air Dump Car equipped with aprons shown at the left can get away in traffic. Only 15 seconds required to dump and right entire train and get under way again.

Western Wheeled Scraper Company

Builders of Air Dump Cars

AURORA 1877 Western 1927 ILLINOIS

What Price Quality?

THERE are many stages in the production of a tie. Each stage must be executed scientifically. A failure in one, means failure in all.

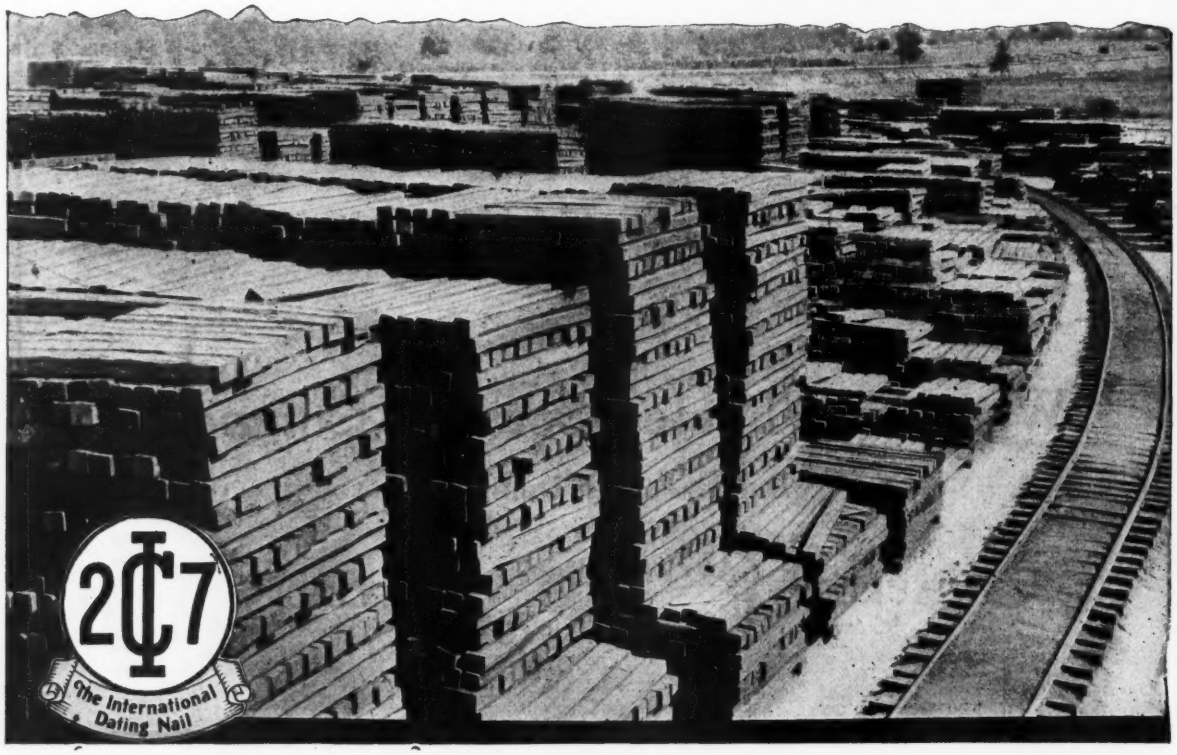
It costs money to grade a tie storage yard, tile drain it and keep it free from vegetation. It costs money to promptly transfer the ties from the right-of-way to the storage yard; to inspect each one separately for decay; to stack the ties properly and to supervise them minutely during seasoning. But all this is necessary.

The added care may increase the cost five per cent—but lack of such care will reduce the tie life in track 25 or even 50 per cent. ***International*** spends thousands of dollars annually to produce and season ties right, in order to protect the interests of and save money for, its customers.

Contract now with ***International*** to produce and treat your ties on an annual basis.

International
STANDARD A.R.E.A.
SPECIFICATION TIES

International Creosoting & Construction Co.
General Office—Galveston, Texas



A TRIUMPH OF DESIGN

Test of Manganese Steel Crossing Intersections

AMSCO PROCESS TUBULAR INTERSECTION [B]

VS

ORDINARY INTERSECTION [A]

Ordinary Intersection [A]

2¼ inch metal under the flangeways.
4¼ inch metal under the tread.
Weight of casting 464 lbs.

Tons Pressure	Time	With Pressure on Deflection	With Pressure Off Set
100	5 Minutes	¼ inch	None
150	5 Minutes	¼ inch	1/16 inch
200	5 Minutes	1/16 inch	1/16 inch
250	5 Minutes	½ inch	⅜ inch
300	5 Minutes	.....	⅞ inch
350	1 Minute	Badly broken in the intersection	

AMSCO Intersection [B]

1 inch metal under the flangeways.
1⅜ inch metal under the tread.
Weight of casting 528 lbs.

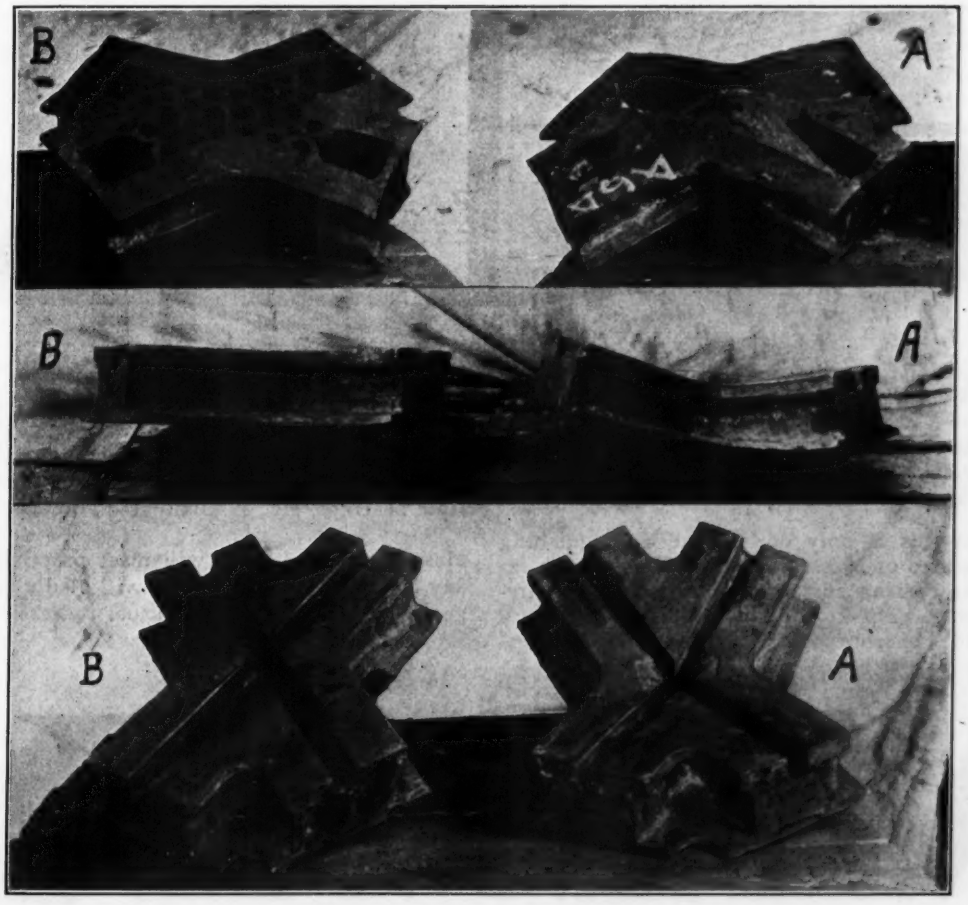
Tons Pressure	Time	With Pressure on Deflection	With Pressure Off Set
100	5 Minutes	⅛ inch	None
150	5 Minutes	⅛ inch	1/32 inch
200	5 Minutes	⅛ inch	1/32 inch
250	5 Minutes	⅛ inch	1/32 inch
300	5 Minutes	1/16 inch	1/32 inch
350	1 Minute	¼ inch	⅛ inch

One rib underneath the intersection showed slight crack

They last longer

They ride easier

They cost less to maintain

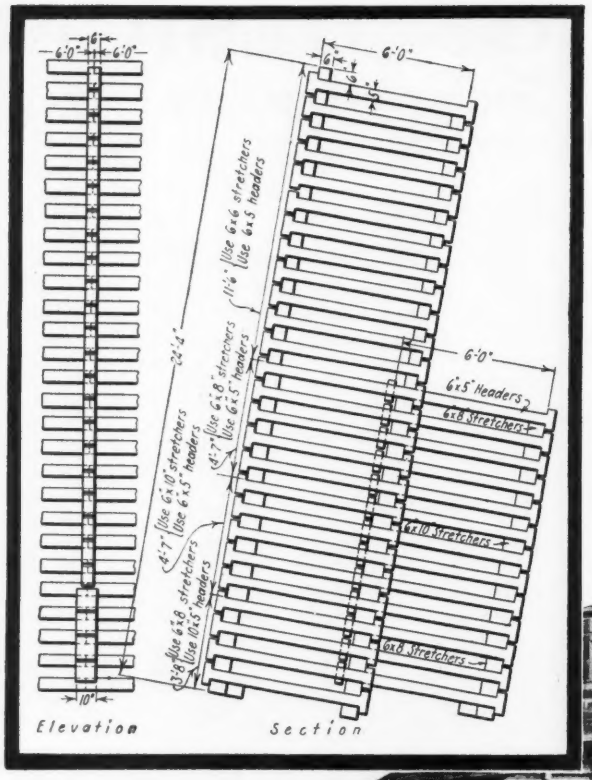


The tubular construction provides uniform metal and prevents cracking at intersections

Buy the Tubular Bottom AMSCO when replacing your next Manganese Crossing

LOUISVILLE FROG & SWITCH COMPANY

LOUISVILLE KENTUCKY


6'-0"
6'-0"
6'-0"

$40,000,000
SAVING IN MAINTENANCE

EIGHT million dollars expended annually for cross ties is typical for Class I Railroads.

Extending tie life five years by eliminating mechanical abrasion through the use of Lundie Tie Plates makes possible a saving of $40,000,000 over a twenty year period.

Cross ties are the largest item of maintenance of way expense. More ties are destroyed by mechanical wear than by decay—so the Lundie Tie Plate offers the greatest opportunity for maximum reduction of maintenance of way costs.

Minimizes Mechanical Wear

LUNDIE Tie Plates are as essential as creosoted ties—money spent on costly treated ties is lost when the cutting ribs of practically all tie plates break down the wood fibers, allowing moisture to penetrate below the safety line.

Lundie Tie Plates are more than mere tie plates—they are positive insurance against mechanical wear. Through scientific design they hold gauge under the most severe conditions without cutting a single fiber of the tie. It is economy to buy the best cross ties obtainable if you protect that investment with Lundie Tie Plates.

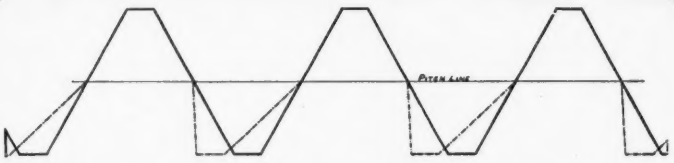
There is no substitute.

The Lundie Engineering Corporation
285 Madison Avenue, New York
166 West Jackson Boulevard, Chicago

LUNDIE TIE PLATE

Compare them!

"They Lock on Every Thread"



Solid lines are U. S. Standard Threads. Broken lines show change on Selflock Threads

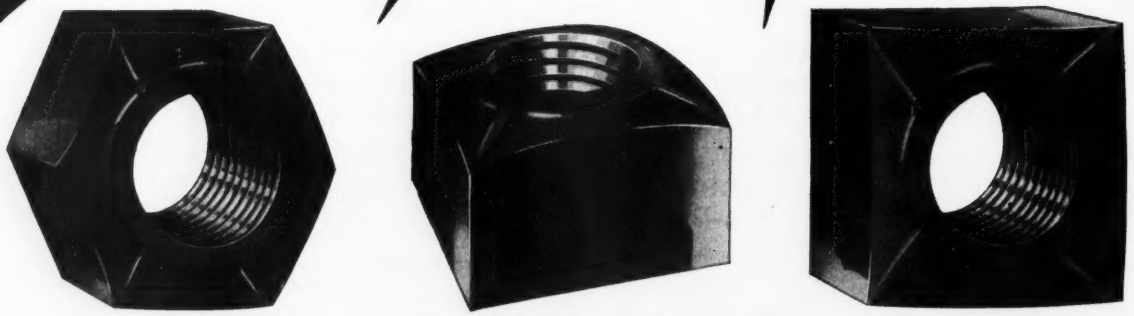
SELFLOCK Unit Nuts are the final result of a fifty-three year search for a positive locking nut that would stay tight under the most violent vibration and strain.

This has been accomplished by the unique application of the principle of friction, developing a gripping frictional contact on both sides of each thread.

In the illustration above, you will notice the peculiar angularity of the Selflock thread.

This changed position of the thread in the nut causes the apex of the U. S. standard bolt thread to form a gripping frictional contact with both sides of each thread.

That's why Selflock Unit Nuts remain permanently tight under all conditions of strain and vibration.



"The Nut with the Star Crown"

GRAHAM BOLT & NUT COMPANY

Established 1874 PITTSBURGH

Complete Tie Tamping Units Mean Undivided Responsibility

Ingersoll-Rand Tie Tamper Outfits are complete units consisting of compressor, pneumatic tampers, and a full equipment of hose and connections —all ready for operation.

With these units there is no division of responsibility—Ingersoll-Rand stands back of the whole outfit. Long experience in the field makes it possible for the Company to offer a superior service, and to give complete instructions regarding the organization of gangs and the care and operation of the units.

INGERSOLL-RAND COMPANY — 11 BROADWAY, NEW YORK CITY

Offices in principal cities the world over

FOR CANADA REFER—CANADIAN INGERSOLL-RAND CO., LIMITED, 260 ST. JAMES ST., MONTREAL, QUEBEC

237-TT

Ingersoll-Rand

THERMIT RAIL WELDS ELIMINATE THE JOINTS

Rail joints when buried in pavement at highway crossings, in station platforms or in tracks located on public highways are a continuous source of trouble and expense. The rail in such tracks usually has a very short life due to joint failures. All of these difficulties can be forgotten once and for all if the rails are Thermit welded.

This method of welding has been used by most of the progressive electric railways in the United States for many years and now is in use on several of the important railways.

The cost of a Thermit weld is slightly more than that of a bolted joint but the first cost is the last cost and the result is a solid continuous rail. There are no bolts to get loose and no joints to cup and pound.

The process is simple, the equipment light and inexpensive, and your own track men can do the work.

We would be pleased to furnish you with complete information in regard to the process and estimates of the cost of installation.

The First Cost Is the Last Cost

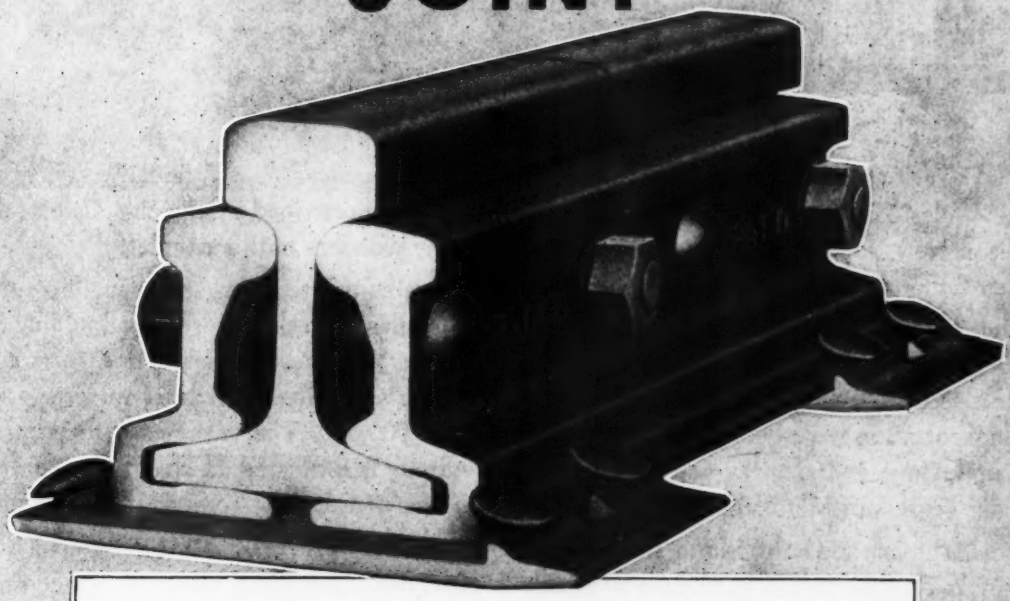
METAL & THERMIT CORPORATION

120 BROADWAY, NEW YORK, N.Y.

PITTSBURGH CHICAGO BOSTON SOUTH SAN FRANCISCO TORONTO

KEEPING PACE WITH PROGRESS

HEAD FREE Continuous JOINT



THE Head Free fillet bearing area can never be diminished.

A cocked Head Fishing bar reduces the head bearing to almost a line.

THE RAIL JOINT COMPANY

165 Broadway, New York City

RAIL JOINTS

OVER two million cubic yards of rock blasted literally from under the very feet of New Yorkers—without even jarring their famous metropolitanism!

Since the adoption of plans for the Eighth Avenue Subway in 1925, contractors under the direction of the New York City Board of Transportation have been busily blasting a 57-mile tunnel under the most congested traffic centers of Manhattan and Brooklyn.

Steam shovels and motor dump trucks crawl over and under and in between a labyrinth of tubes, tunnels, gas and water mains Small charges of du Pont explosives, aggregating many tons, are being fired under the rumble of great trucks, scurrying taxis, and hurrying pedestrians, with all the safety precautions prescribed by the city. One of the many wonders of this wonderful city.

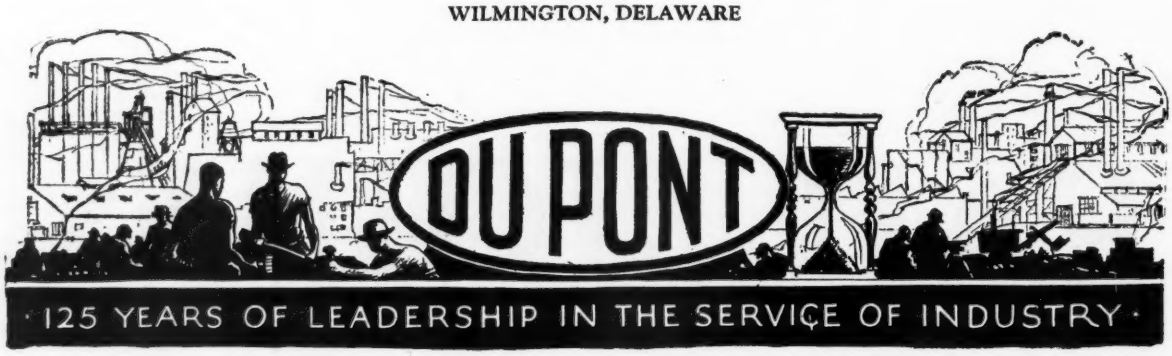
When completed, this subway will contain 170 miles of track—more than doubling the subway facilities of New York. The cost of construction will be approximately $400,000,000. The entire cost of this great subway is estimated at a half billion dollars—one of the most remarkable enterprises in the history of city government.

Du Pont laboratories, du Pont engineers and field service men are working constantly with users of explosives, making available the knowledge and skill of 125 years of explosives experience.

E. I. DU PONT DE NEMOURS & CO., Inc.

Explosives Department

WILMINGTON, DELAWARE



"Bring on another!"

One man with a Hayward Bucket coals a locomotive, and is ready for another in short order.

A Hayward is a "greedy" bucket. Watch one dig and see the big heaping load it takes—more than its rated capacity. Note its high speed operation.

Let Hayward Engineers advise you; their experience and knowledge of railroad needs can help you to get a "bucket fitted for the job."

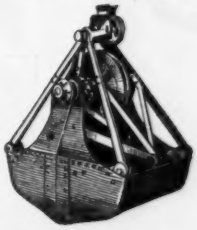
THE HAYWARD COMPANY

46 Dey Street New York, N. Y.

Builders of Clam Shell, Drag Line, Orange Peel and Electric Motor Buckets; Dredging, Excavating, and Coal Handling Machinery, Automatic Take-Up Reels; Counterweight Drums.

Hayward Buckets

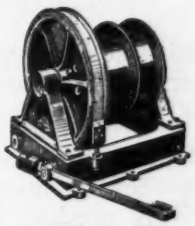
Electric Motor Buckets



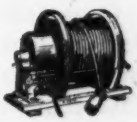
Clam Shell Buckets

Orange Peel Buckets

Drag Scraper Buckets



Counterweight Drums



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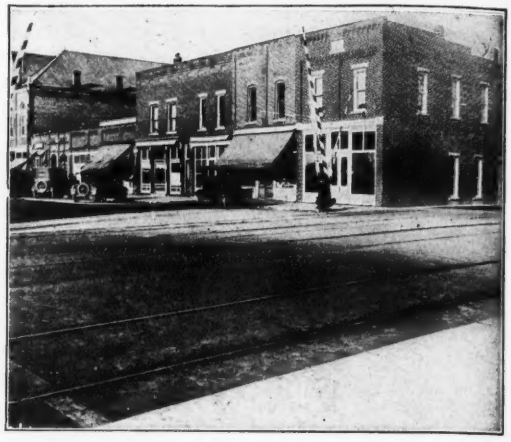

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TRADE - MARK

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BITUROC Crossing, Cincinnati, O.

Bituroc is a natural bituminous sandstone quarried and pulverized at our plant at Summit, Hardin County, Kentucky.

During the past two or three years there has been an enormous increase in the use of this product by Railroads for railroad crossings and station platforms and other uses. Great satisfaction has been obtained by every railroad that has used the product. Enormous saving in up-keep has resulted—ultimate cost being greatly reduced.

The material is shipped in open top coal cars ready to lay COLD. Any section crew with ordinary tools can do the work. If rollers are available, we recommend them. If not, it can be satisfactorily hand tamped.

Bituroc, due to its elasticity and resiliency, will withstand the vibration and impact of combined vehicular and rail traffic, where a more rigid type of pavement will crack and disintegrate under the strain.

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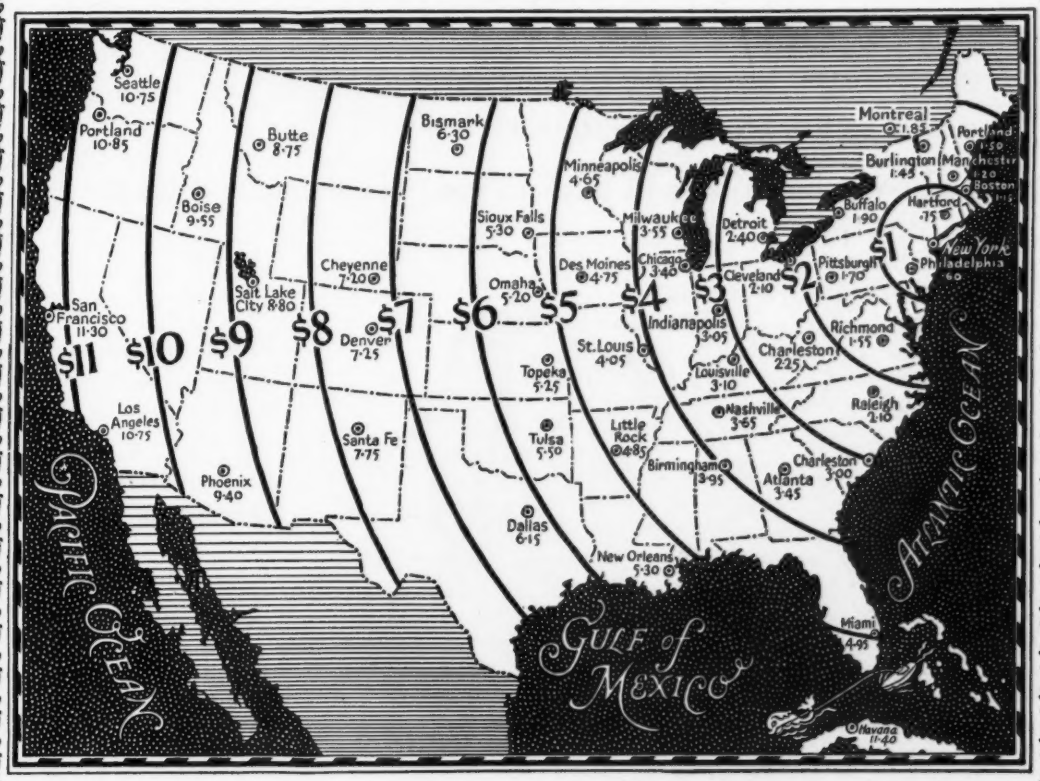

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What far away call should you make now.....number, please?.....

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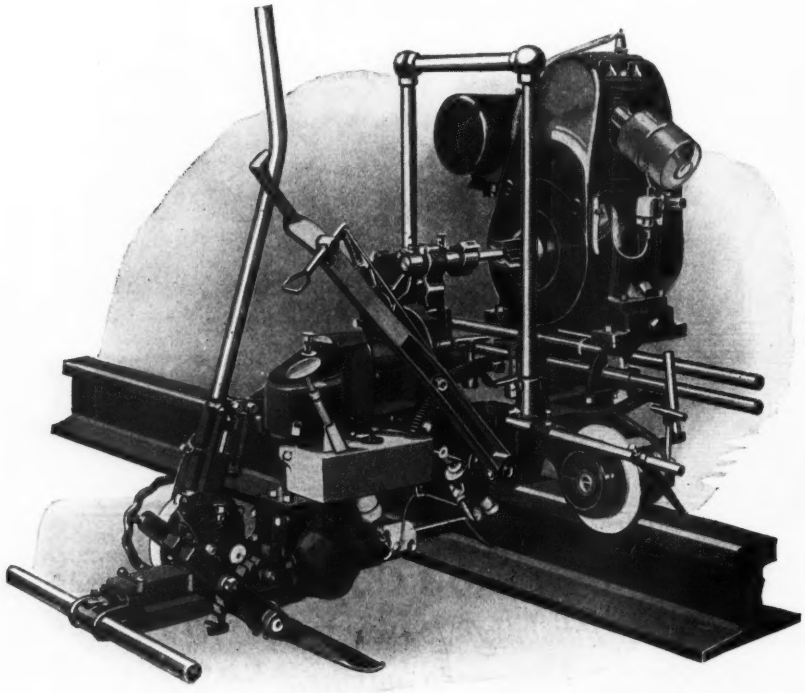
The Everett Power M-W Track Drill

IN addition to the 27 to 40 cents per pole saved on drilling, the Everett Power M-W Track Drill can now be equipped with a chuck to run up nuts and save a large part of the time and labor formerly required.

This chuck increases the usefulness of the drill and insures a greater return on the investment.

Add both the Drill and Chuck to your maintenance equipment.



(Patents Issued and Pending)

It will drill up to 1½" holes through web of rails any size from 65 to 150 lbs.

It will drill web of rail through splice bar.

It will drill rail when in or out of track.

It will drill holes to within 2½" of end of rail with no rail adjoining.

AND NOW

It will run up nuts to within ½ turn of permanent tightness.

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Railway
Engineering and Maintenance

Volume 23 April, 1927 Number 4

ARE YOUR DITCHES OPEN?

THIS IS the season of the year when one may expect the maximum run-off. Frequently it comes unexpectedly without opportunity for preparation. Late falls of snow or of rain on snow already on the ground greatly increase the run-off and tax waterways to the limit. The only safe course is to be ready for these floods whenever they come by seeing that all ditches and other waterways are open and of adequate section, that the entrances to culverts are free of debris, and that all other reasonable precautions are taken for the ready escape of the water. It is better to spend time in preparation than in repair—and safer.

WHY EARLY STRENGTH CONCRETE?

THERE WAS once a bridge engineer who opposed the use of concrete because he "could not see any sense of breaking up stones into little pieces, only to paste them together again." There was a time such reasoning was not far wrong. Concrete was used only as a substitute for stone and with good stone masons to be had at low wage rates and little or no machinery available for making concrete, the cost of ashlar stone masonry was so little more than that of concrete that the added expense could readily be justified on the ground of greater certainty of permanence. This condition no longer obtains. Concrete is now much cheaper than stone masonry, not only by reason of the actual comparative labor and material costs, yard for yard, but also because the use of reinforcement permits construction with lighter sections in concrete than in stone, while in addition, reinforcing has made concrete available for many purposes to which stone masonry is not applicable.

To these advantages of concrete another has now been added. For, whereas concrete work has always been undertaken with the definite understanding that the structure must not take load for a considerable period of time after its completion it is now possible to make concrete that will have a strength in 24 hours equal to the ordinarily expected only at the end of 28 days. That the railways are keenly alive to these possibilities is evident in the references made in two articles appearing in this issue to the use of special brands of cement for the purpose of securing early high strength concrete.

However, as stated in a third article, marked opportunities along this line are also afforded by the intelligent use of standard Portland cements with or without special admixtures. This is one of the benefits resulting from the great attention which has been given to studies of the underlying causes for variations in the strength of concrete. In brief, it has been shown that measures designed to insure higher strength of concrete, if carried out to a greater degree of refinement, will insure greater early strength. It is true that this implies the use of greater proportions of cement than are ordinarily employed but exactly as with the use of the special brands of cement, the greater cost can often be justified by the savings effected by reason of the earlier use of the structure.

MAKE A RECORD NOW

IN MANY respects winter places the most severe burden on the track and it is then that certain deficiencies become most evident. As an illustration, it is frequently only when track heaves that inadequate drainage of the roadbed is evidenced. At this season when winter is rapidly giving way to spring, it is not unnatural that track men should feel a sense of relief and forget their troubles of the recent past as they enter into their more active programs of the open season. Yet it is highly important that before undertaking their spring work they review their troubles of the winter while they are still fresh in mind and make a definite record of them, as to their exact location, cause and the remedial measures necessary in order that they can, as far as possible, put these remedial measures into effect during the summer and thereby avoid a recurrence of the troubles next winter. In this way by constantly removing the worst spots, the standard of a property can be gradually but steadily raised and the forces permitted to devote more and more of their time to constructive work.

AN OBJECTIVE WILL HELP

WHETHER one's jurisdiction is confined to a section, a division or a system, he will do his best work when he has an objective to strive for. Without such a goal his work will be more or less disconnected and a certain amount of lost motion will inevitably creep in. If, on the other hand, the objective is such as to tax his ability and that of his forces their efforts will be greater and better directed as they strive to reach the goal.

Maintenance forces are now starting a new season's work. They are beginning a program which has for its immediate purpose the making good of the winter's wear and tear of the elements and of traffic. Much of this deterioration is inevitable and must be overcome from time to time. A part, however, can be eliminated by more thorough and more permanent reconstruction. To do over and over what can be eliminated by more thorough measures

is wasteful of labor and of materials. It is through the realization of this fact that maintenance men can find opportunities for the permanent improvement of the properties under their direction. By noting such places and by selecting certain of them for more thorough treatment, marked betterment can be effected in a few years' time and the labor previously spent here can then be devoted to other and more constructive purposes.

The railways are growing institutions. Their traffic is increasing. The demands for more economical and more dependable service are constantly becoming more exacting. It is not enough, therefore, for a property to be maintained in a stationary condition. Rather it must constantly be improved. That foreman, that supervisor, and that engineer maintenance of way, who, in addition to carrying on his routine work, selects certain deficiencies on his territory for improvement during each season and makes these improvements as opportunity offers, will find that it will not be long before his territory as a whole will be brought to higher standards and his forces will be able to devote more and more of their time to work of this character.

THE LABOR SHORTAGE THAT DIDN'T OCCUR

ONE OF THE surprising features of the industrial activity of the last year was the comparatively easy labor situation throughout the country, despite the tremendous output of manufacture and the large railway construction and betterment programs that were carried on. As far as the railways were concerned this may be attributed to two factors: One, the increasing amount of winter work that is being done by the railways and the other, the growing use of labor-saving machinery, not only on the railways but in manufacturing and agricultural industries as well.

In the field of railway maintenance, each of the two factors supplements the other. Much of the work that is done successfully by maintenance forces in the winter would not be possible, economically, without the use of mechanical devices. Thus, rail renewal is carried on during the winter months, thanks to the use of machinery of various types for picking up and setting in the rails, where the use of tong men for this purpose would be not only slow and costly, but dangerous as well, due to the hazards of slipping on ice and snow. Labor-saving machinery, besides making winter work feasible, also helps to pay for itself by making it possible to keep it employed over practically the entire year, thus reducing its overhead cost.

Interest on the investment keeps on working just the same, whether the machine is busy or idle, and as far as depreciation is concerned, this should be measured by units of output rather than by elapsed time. Any machine may be considered capable of turning out a certain amount of work and if this can be secured in a given time by keeping the machine in constant use the depreciation per unit of output is no greater than if it lasted twice as long, due to being employed only half the time. Indeed, the quicker a machine can be made to deliver its life's work the better position will the user be in to take advantage of new machines embodying the improvements which are being made constantly.

Not the least of the advantages of winter work and labor-saving machinery are their influence in making maintenance work attractive to men who have heretofore been reluctant to enter it. Two of the principal objections to track work have been the fact that it was carried on for only about two-thirds of the year, coupled with the fact that as carried on in the past, it meant drudgery. Labor-saving machinery, by making possible steady employment for a greater number of men, is doing much to improve the personnel of maintenance forces, while eliminating many of the disagreeable features of the work.

THE SUPERELEVATION OF CURVES

THE IMPORTANCE of the proper maintenance of the superelevation of curves is emphasized by Accident Bulletin No. 94, covering railroad accidents for the calendar year 1925, which has been issued by the Interstate Commerce Commission. Data in this bulletin show that 287 train accidents were caused by unevenness in the superelevation of the track, resulting in injuries to 13 persons, 7 of whom were passengers.

This is a matter that competent supervision should be able to correct, for with the exception of some few cases due to unforeseen slides or subsidence, uneven superelevation is the result of neglected maintenance. Where such conditions are prevalent, and it usually will be found that they do not occur in isolated cases, the remedy is increasing supervision until the maintenance of the prescribed elevation throughout the length of the curve becomes a fixed habit with those in charge of the track. It is important that steps be taken promptly to put the track in proper condition as soon as irregularities are discovered, for neglect soon causes the track to go out of line, with a further tendency to poor surface and the result is extremely rough riding track, even if conditions do not become serious enough to cause accidents.

One of the requisites for maintaining a uniform superelevation is good track material properly installed, but assuming that this has been taken care of the next thing is to check the superelevation frequently with the track level, for it is impossible to ascertain unevenness in the elevation by the eye alone. Many a foreman who thinks he has well maintained curves is surprised to find that high speeds have a way of finding rough spots when he rides over them on a fast train.

CURB THE RESPIKING OF TIES

CONTRARY to the conditions that prevailed almost universally a couple of decades ago, decay need no longer be the principal reason for the removal of ties from tracks. Instead there is ample evidence to show that it is now practicable to treat ties with preservatives so as to give them a greater resistance against decay than they now possess against the mechanical destruction to which they are subjected. It has been demonstrated on more than one road that ties can be rendered immune to decay for 20 years or more, but as much cannot yet be said for the protection against other destructive agencies.

Now that two-thirds of the ties inserted in tracks are treated with preservatives to protect them against decay, it is necessary to give more attention to their protection against rail cutting, shattering, spike killing and other forms of mechanical destruction. Tie plates of adequate size offer protection against rail cutting and on many roads this form of deterioration is no longer a problem. Some progress has also been

made in the reduction of shattering by the substitution of a petroleum-creosote mixture in place of straight creosote or zinc chloride treatment.

Less progress has been made in overcoming the destructive effects of spike killing. Of 38,000 creosoted ties removed from the tracks of the Atchison, Topeka & Santa Fe because of the exhaustion of their service life and which were examined by inspectors of the treating department of that road during the last three years, 49.9 per cent failed because of spike killing while only 0.4 per cent came out primarily because of decay, according to a statement made by R. S. Belcher in an article on the Santa Fe's experience in prolonging the life of ties which appears on page 150 in this issue. This condition shows the need for the extensive study of ways of reducing the detrimental effects of spike killing for it is through this avenue that the next increase in tie life may be expected.

The injury from spike killing arises not only from the mashing of the wood fibres by the spike, but also by reason of the entrance afforded for water into the untreated wood in the interior of the tie. This condition is being met in part by boring the ties for spikes before treatment, thereby sterilizing the wood more effectively around the spikes and decreasing the distortion of the timber when the spikes are driven. In view of the evident advantage of this practice in prolonging the life of the ties, it is surprising that more roads are not adopting it. Having provided ties with holes bored in them it is up to the railroads to make sure that the spikes actually be driven in these holes and that whenever they are withdrawn the holes be filled with treated plugs.

Even more important, however, in a campaign for the reduction of spike killing is the elimination of all unnecessary redriving of spikes. By this it is not meant to discourage any redriving that may be necessary for the renewal of rails, the regaging of track or other necessary maintenance operations. However, only casual observation is necessary to show that many spikes are withdrawn and redriven unnecessarily—with destructive effect on the ties. This is an operation which foremen and roadmasters can well afford to check carefully to insure that spikes are withdrawn and redriven only when necessary and that their work is so planned as to eliminate any unnecessary redriving. No single measure will do more to increase the life of ties than this. For this reason it deserves the careful consideration of every maintenance officer concerned with tie conservation.

Through the Corn Fields of Missouri on the Missouri Pacific.

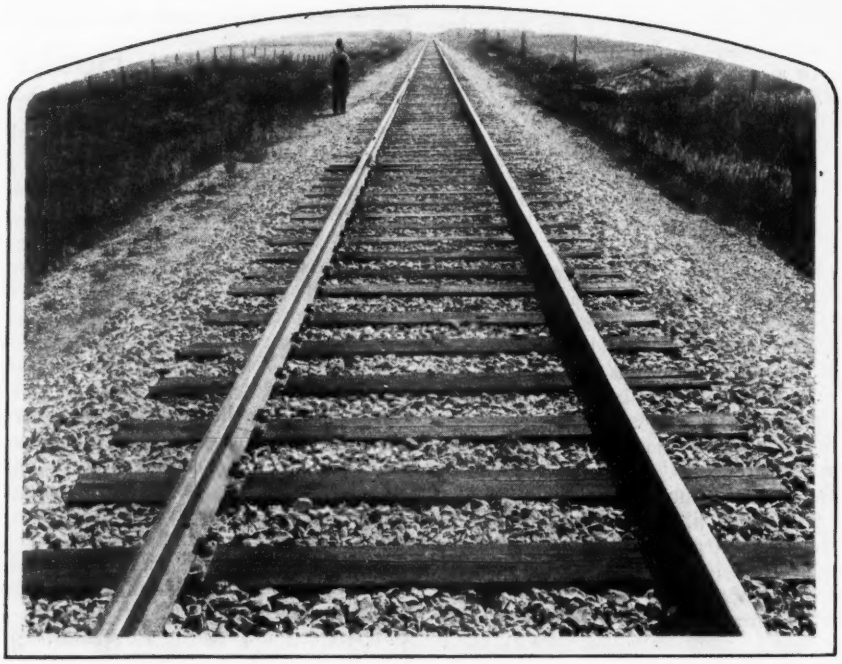
New Books

Proceedings of the 44th Annual Convention of the Roadmasters' and Maintenance of Way Association. 216 pages, 7 in. by 10 in. Bound in cloth. Published by the association, T. F. Donahoe, secretary, 428 Mansion Street, Pittsburgh, Pa.

This is the complete report of the annual convention of this association which was held at Chicago on September 21 to 23, 1926. It contains the papers, committee reports and addresses presented at the various sessions, together with a stenographic report of the discussion. While the association has been conducted on a policy of developing its programs largely with the idea of offering the members an opportunity to participate actively in the work of committees charged with the preparation and presentation of reports on assigned subjects, it is also calling on ranking railway officers in various departments to participate in the program through the presentation of papers and addresses. Thus, in the present volume there will be found papers and addresses by R. H. Aishton, president of the American Railway Association; T. H. Carrow, chairman of the Safety Section of the A. R. A. and supervisor of safety of the Pennsylvania; J. V. Neubert, engineer maintenance of way of the New York Central; H. J. Pfeifer, chief engineer of the Terminal Railroad Association of St. Louis; Lem Adams, maintenance assistant, president's staff of the Union Pacific; J. S. Hyatt, general manager of the Chicago, North Shore & Milwaukee; and C. A. Morse, chief engineer of the Chicago, Rock Island & Pacific. Among committee reports to be found in this volume are those covering such subjects as the repair of tools; the maintenance of track joints; greater uniformity of employment; and the construction and maintenance of highway crossings.

Practical Structural Design. Third edition, revised and enlarged. By Ernest McCullough, consulting engineer. 416 pages, 6 in. by 9 in. Illustrated. Bound in cloth. Published by the Scientific Book Corporation, 13 East 26th Street, New York. Price, $4.

A review of this book by anyone who is possessed of a thorough knowledge of structural engineering leaves much to be desired because it is difficult for such a reviewer to put himself in the position of the man for whom the book is written, namely, one who desires to perfect himself in the theory and practice of structural design without the advantage of a thorough grounding in higher mathematics and theoretical mechanics. While, therefore, the explanations, formulas and graphic methods presented may appear to the experienced designer to be entirely clear, he cannot be certain that the matter would be readily understandable to the man who undertakes to read it with only a fair knowledge of arithmetic and a "good head." The first chapter launches directly into the theory of beams, dealing first with external forces and then with the less tangible internal forces. The exposition is illustrated with practical examples in wood, steel and reinforced concrete. Following this is a treatment of the frame structure, including its application to roof trusses, bridge trusses, towers, etc. Columns also receive individual attention, as do retaining walls, foundations, etc. Considerable space is also devoted to details such as the framing of wooden trusses, rivet spacing in steel work and the details of reinforced concrete construction. While frequent use is made of formulas, the presentation is usually followed by illustrations of their application, using numerical values.



Creosoted Pine Ties Laid on the Hutchinson-Kinsley Cut-off in 1910

Better Care of Treated Ties*

How the Life of This Class of Material May Be Prolonged by Avoiding Improper Conditions

By R. S. BELCHER

Manager Treating Plants, Atchison, Topeka & Santa Fe, Topeka, Kan.

THE railroads are watching their tie renewals more closely each year. They should, because the cost of cross-ties is one of the big items of maintenance. The railways of this country spend more money for timber of all kinds than for any other kind of material except fuel; they consume about one-fourth of the timber cut each year. About 112,000,000 ties were purchased in 1925, which cost in the neighborhood of $125,000,000. Some of these were given preservative treatment which added considerably to this figure. You can estimate better than I how much more it cost to put them in track and take the old ties out. We, as railway employees who are using ties daily, can, therefore, do much by the proper handling and careful use of ties to further practical economy of maintenance and contribute to the conservation of the timber resources of the nation.

As the railroads consume such a large part of the timber cut each year, so also they were the pioneers in the preservative treatment of timber. The first ties were treated in this country 88 years ago but it is only in comparatively recent years that any considerable portion of our ties have been given preservative treatment. In 1924, 63,000,000 or about one-half of the ties purchased were treated. On the Santa Fe tie treatment was started in 1885 and 80,000,000 were treated from 1885 to 1926.

The practical economy resulting from the use of treated ties is strikingly demonstrated by the result of a study made of the tie renewals on the system since 1898. The number of treated ties in Santa Fe tracks was not sufficient to affect the annual tie renewals until about 1909, but from that time until the present there has been a consistent decrease in the number of ties required each year for renewals per mile of track. There has been an increase in the system mileage each year, which was taken into account in the study and which has its effect in reducing the number of renewals per mile, but the summary also shows that during the year 1909, with 12,980 miles of maintained track of all kinds, about 3,750,000 were required, while in 1925, with 18,055 miles of track, a little less than 2,000,000 ties were required, a little more than half the ties used in 1909 and with about 40 per cent more miles of track. Although the preservative treatment is the prime factor in making these results possible, yet tie plates, better track drainage, ballast, machine boring and adzing of ties prior to treatment, and careful maintenance in general have contributed much to longer tie life.

Causes of Tie Failures

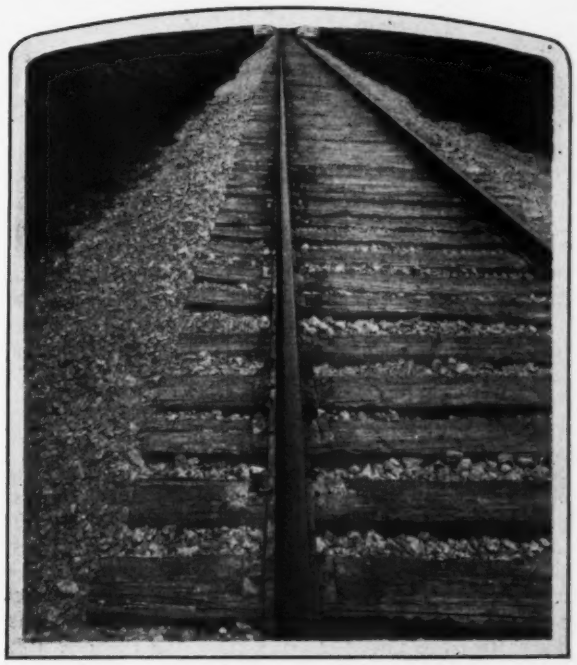
Before we can make any well directed efforts towards increasing the length of service of our ties in track, we must first know, in a general way at least, the reasons for their failure, much as a physician must first diagnose the ailments of his patients before he can prescribe a remedy. During the past three years, inspectors from the treating department of the Santa Fe have examined some 290,000 old ties taken out of

*From an address presented before the Maintenance of Way Club of Chicago, on January 13, 1927.

track. They have classified the causes of failure as decay or rot, spike killed, shattered, accident, rail cut and burned. They have found a few other causes of failure, but the number of ties coming out from such causes is so small that they may be ignored. These are shown in a tabulation, separated as to kind of treatment and kind of wood. As you know, it is not always easy to determine just why a tie has failed and many ties taken out of track show a combination of two or more of the causes noted on this statement, but this classification has been made by our inspectors on the basis of the primary cause of failure.

Let us consider the creosoted ties first. Out of about 38,000 creosoted ties examined, only 0.4 per cent failed primarily by reason of decay, but 49.9 per cent failed on account of spike killing. The term, "spike killing," as we use it, includes decay if this decay exists around the spikes and in the untreated heartwood of the tie, apparently due to moisture having accumulated in the damaged wood fibre alongside the spike and progressing from there into the untreated heartwood. Of the creosoted ties on this statement, 45.5 per cent failed on account of shattering and with this we include decay which may be due to the untreated heartwood of the tie having been exposed to decay by reason of deep checks, splits, ring shakes, etc., all of which go to make up "shattering." Only 3.8 per cent of the creosoted ties came out account of accident, which in general means broken by derailment. Three-tenths of 1 per cent of the creosoted ties came out on account of rail cutting and two-tenths of 1 per cent were burned.

Until a few years ago, comparatively few treated ties were used west of Albuquerque on the Santa Fe for the reason that there were available for that territory ties of redwood, cedar, Japanese oak, ohia and eucalyptus, all woods of natural durability that were used untreated. It so happens that this report covers 167,000 untreated ties of the woods just mentioned, together with some Douglas fir, white oak, gum and pine. Three-fourths of these ties have failed by reason



Creosoted Pine Ties Inserted in 1906 Near Melvern, Kan.

Kind of Treatment	Kind of Wood	Percentages Removed Account of: Rot		Spike Killed		Shattered		Accident		Rail Cut		Burned	
		No. Ties	Per cent	No. Ties	Per cent	No. Ties	Per cent	No. Ties	Per cent	No. Ties	Per cent	No. Ties	Per cent
Creosote	Heart Pine	38	0.1	16714	51.4	15048	46.2	631	1.9	97	0.3	14	0.1
"	Sap Pine	16	0.5	769	24.2	1675	52.9	664	20.9	38	1.2	10	0.3
"	Heart Gum	20	4.7	383	90.3	4	1.0	16	3.8		0.0	1	0.2
"	Sap Gum	72	15.3	252	53.6	37	7.9	109	23.2		0.0		0.0
"	Heart Oak		0.0	788	85.5	110	11.9	24	2.6		0.0		0.0
"	Douglas Fir		0.0	7	1.9	358	98.1		0.0		0.0		0.0
"	All	146	0.4	18913	49.9	17232	45.5	1444	3.8	135	0.3	25	0.1
Crude Oil	Heart Pine	1931	84.5		0.0		0.0		0.0		0.0	355	15.5
"	Sap Pine	33	86.8		0.0		0.0	5	13.2		0.0		0.0
"	All	1964	84.5		0.0		0.0	5	0.2		0.0	355	15.3
Mixture	Sap Oak		0.0		0.0		0.0	6	100.0		0.0		0.0
"	Sap Pine		0.0		0.0		0.0	18	100.0		0.0		0.0
"	Douglas Fir		0.0		0.0	29	90.0	3	9.4		0.0		0.0
"	All		0.0		0.0	29	51.8	27	48.2		0.0		0.0
Allardyce	Heart Pine	421	66.4		0.0	212	33.4	1	0.2		0.0		0.0
Zinc	Heart Pine	44375	64.7	6749	9.8	16999	24.8	414	0.6	2	0.0	21	0.1
"	Sap Pine	2971	32.0	2816	30.3	3103	33.3	398	4.3	5	0.1		0.0
"	Heart Gum	179	11.1	1426	88.5	7	0.4		0.0		0.0		0.0
"	Sap Gum	73	77.7	4	4.3	12	12.7	5	5.3		0.0		0.0
"	Heart Oak	333	25.6	613	47.0	352	27.0	5	0.4		0.0		0.0
"	Douglas Fir	15	2.9	18	3.5	479	92.3	7	1.3		0.0		0.0
"	Heart Spruce		0.0		0.0	148	100.0		0.0		0.0		0.0
"	All	47946	58.8	11626	14.2	21100	25.9	829	1.0	7	0.0	21	0.0
Untreated	Heart Pine	5006	95.0	235	4.5	28	0.5		0.0		0.0		0.0
"	Sap Pine	25454	73.4	1113	3.2	1084	3.1	1005	2.9	6042	17.4		0.0
"	Heart Gum	980	95.0	41	4.0	11	1.0		0.0		0.0		0.0
"	Sap Gum	29	93.5	2	6.5		0.0		0.0		0.0		0.0
"	Heart Oak	22903	93.5	718	2.9	822	3.4	47	0.2		0.0		0.0
"	Sap Oak	608	100.0		0.0		0.0		0.0		0.0		0.0
"	Heart Cedar	10446	94.2	621	5.6	17	0.2		0.0		0.0		0.0
"	Redwood	10822	50.2	7617	35.3	1287	6.0	533	2.5	1280	5.9	17	0.1
"	Cypress	5182	85.0	856	14.0		0.0	58	1.0		0.0		0.0
"	Jap Oak	28942	91.6	2101	6.6	557	1.8		0.0		0.0		0.0
"	Ohia	435	11.4	351	9.2	3022	79.4		0.0		0.0		0.0
"	Eucalyptus	406	8.0	501	9.8	4181	82.2		0.0		0.0		0.0
"	Douglas Fir	17153	78.6	388	1.8	3830	17.6	249	1.1	203	0.9		0.0
"	All	128366	76.8	14544	8.7	14839	8.9	1892	1.1	7525	4.5	17	0.0
All	All	178843	61.8	45083	15.6	53412	18.4	4198	1.4	7667	2.6	418	0.2

Statement Showing Causes of Failure of Ties on the Santa Fe

of decay. The remedy for decay is preservative treatment and I am glad to say that with the exception of some few redwood ties on the west coast we are now using treated ties only on the Santa Fe.

Decay results from the action of certain low forms of plant life which depend for their sustenance on certain substances in the wood and as these substances are dissolved the structure of the wood is broken down until it reaches the conditions commonly known as rotten. If, therefore, the wood itself, the food of the decay-producing organism, is poisoned, as is the case when the cells of the wood are impregnated with a toxic preservative such as creosote or zinc chloride, it is impossible for decay to develop in the treated wood so long as the preservative remains.

Test Sections Show Possibilities

We have 284 miles of ties in track which are checked each year, so that we know just what service we have obtained from each group of ties to date. The accompanying photographs show some of the groups of ties in this test track. In 1906, 24,000 hewn Texas pine ties treated with approximately 4½ lb. of creosote per cubic foot by the Rueping process were laid in track near Melvern, Kan., between Ottawa and Emporia. These ties are under heavy traffic; the track is rock ballasted and a part of the ties were plated with 6-in. by 8-in. three-hole plates at the time the ties were laid, but the larger portion were not plated at all until 1914 when 90-lb. rail was laid, at which time the standard 7½-in. by 9-in. plates were used. The ties were slightly rail cut and were therefore adzed somewhat when the 7½-in. by 9-in. plates were applied. These ties have now been in track 20 years with only 11 per cent removed for all causes.

We have another lot of creosoted Texas pine ties, approximately 41,000 of them, treated with 5 lb. of creosote by the Rueping process and laid in track in 1910 between Hutchinson, Kan. and Kinsley. These ties are also in rock ballast and under heavy traffic. They are plated with 7½-in. by 9-in. plates. A portion of these contain screw spikes and the remainder cut spikes. These ties have been in service 15 years and only 3 1/3 per cent have been removed for all causes. In the same year and in the same track, 9,436 sawn Texas pine ties, treated in the same way were laid. About 16 per cent of these have been removed for all causes, but the record shows that most of these came out on account of derailments. In this same track and during the same year, 14,497 hewn Texas gum ties of the same treatment as the pine were placed in track under the same conditions. The 1926 inspection shows that only 0.75 per cent of these ties have been removed for all causes during the 16 years of service.

Other Ties With Long Service

I have another piece of track in mind which we have not considered as test track, but we have records of the original ties and the renewals made to date. The ties in this track, which were hewn Texas pine, treated with 5 lb. of creosote, do not show up as well as the ties in the tests before mentioned, but, nevertheless, are making a good showing and are of interest chiefly because of the large number of ties of one kind of the same age. The track is located in Texas between Coleman and Sweetwater and was built in 1910. Exclusive of side tracks, out of 260,000 ties in this 84 miles of line, 61,718 ties, or 23.3 per cent have been removed during the 16 years of service. This piece of track is in such excellent condition at the present time that in all probability renewals for the next three or four years will be extremely light and it seems that we may expect something like 20 years average life out of this lot of ties.

Life of Treated Ties

I am frequently asked the question: "How long will a treated tie last?" It is a hard question to answer. No one figure will cover all kinds of treated ties in all parts of the country. For this reason I have mentioned the above groups of ties on the Santa Fe which give promise of such excellent results, and from these you can form some opinion as to what may be expected from treated ties under rather favorable conditions.

Let us consider a little further the condition of some ties which have lived their life. You have seen pictures of the creosoted pine ties in track at Melvern, Kan., which have been in service 20 years. Pictures are shown of six of these ties taken out of track recently, the right hand portion of the picture showing the bottoms of the same ties. Tie No. 2 would have been good for several more years of service. The others are quite ready to come out. Note the sound condition of the bottoms of these ties.

A picture is shown of tie No. 2 of this group, cut at the inside spike and at the middle of the tie. The tie was somewhat wet when cut, but the timber under the rail was practically sound. The dark color of the two cross sections at the inside spike is due to moisture.

Tie No. 4 is badly plate cut and shows spilt and ring shake, but the timber under the rail is fairly sound. It it wet, and, therefore, looks rather dark in the picture. The middle section of the tie shown at the top of the picture is in pretty good condition except for the ring shake at the top.

A picture shows tie No. 5 of this lot of six, cut in the same manner as tie No. 2. This tie was in the poorest condition of any in this lot and the decayed condition of the interior of the tie is due primarily, in my opinion, to the splitting and checking which admitted water to the untreated center of the tie. We would, therefore, speak of the primary cause of the failure of the tie as splitting and shattering rather than decay, although decay played an important part in the failure of the tie.

[Slides were shown of sections of ties illustrating various causes of failure, prominent among which were shattering and checking, failure to drive the spikes into the holes bored to receive them and distortion of the fibre caused by driving spikes into ties which had not been bored, this practice not only allowing moisture to enter the untreated portion of the wood but also causing the fibre to retain the moisture to a greater extent than would undamaged fibre. Slides were also shown of ties of various kinds of wood, treated with creosote, zinc chloride, and a mixture of creosote and petroleum. Other slides showed the damage caused by cutting off treated timber so that the untreated interior is exposed to the air.—Editor.]

Failures Due to Spike Killing and Shattering

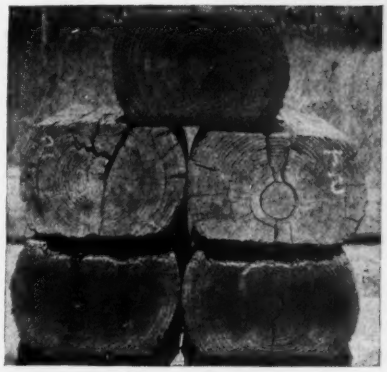
Spike killing, as I have pointed out, is a more or less arbitrary term which has been used in the treating plant department to indicate failure of the tie primarily from the breaking and bruising of the wood fibre caused by the driving of the spike and to decay which frequently occurs around the spike as a result of the breaking and bruising of the wood fibre and the entrance of water around the spike into the untreated interior of the tie. If spike holes are bored in the ties before treatment, the preservative, of course,

penetrates the wood around the spike hole, and if those of us who have to do with putting the ties in track are careful to see that the spikes are driven in the bored holes, we will have done something, at least, to prevent the failure of our ties from spike killing in the future. The proper use of treated tie plugs in treated ties is also very important. The plugs are manufactured so that they will fit snugly in the holes left when a spike is pulled. Every time a spike is pulled a plug should be driven into the hole before the spike is put back. The plug should be driven to the bottom of the spike hole and care used not to break off the plug before it is driven to the bottom of the hole. If we can overcome spike killing, even to a small degree, on the Santa Fe, we shall have lengthened the life of our ties considerably because such a large per cent of our ties fail from this cause.

Perhaps you have another name for what we call "shattering." This term, as we use it, indicates a separation of the fibres of the wood which we may call a shake or ring-shake, combined with checking, which is a separation of the wood along the radii from the pith. This checking and separation of the fibres in time allows moisture to enter the untreated heartwood of the tie and decay to set up therein. While decay may be the ultimate reason for failure of a shattered tie, yet shattering is the primary cause and for this reason we have termed ties which have failed in this way "shattered."

At the Right — Views of the Tops and Bottoms of Five Ties Removed from Track Near Melvern, Kan.

Below — Close-up Views of Three of the Ties Shown at left After Cutting Them in Five Pieces



Creosote and Petroleum Treatment

During the years 1909 and 1914 inclusive, we treated approximately 1,000,000 ties at the Albuquerque treating plant with a mixture of creosote and California crude oil. In view of the excellent result obtained from the ties so treated, supplemented by some experimentally treated mixture ties, placed in test track, the mixture treatment was adopted as standard practice on the Santa Fe in 1923. The mixture treatment now used is 8 lb. to the cubic foot of timber of 50 per cent creosote and 50 per cent petroleum residuum or fuel oil for the Eastern and Gulf Lines and the same quantity of a mixture of 45 per cent creosote and 55 per cent petroleum for the Western and Coast Lines. We have found that the mixture-treated ties show very little tendency to check and shatter. This is due to the effect of the crude oil or petroleum and yet sufficient creosote has been used in the mixture to prevent the growth of the decay-producing organism. In other words, the wood is poisoned in similar manner to the straight creosote treatment but the petroleum has been added to hold back checking and shattering. We expect that the mixture treatment is going to do much to prevent failure of our ties from the causes which we have termed "shattering."

When the treated tie leaves the treating plant we may assume that the man in charge has thoroughly air-seasoned it before treatment, has bored and adzed it for the spikes and plates, has given it the best treatment he knows how, in short, has done everything he can for the tie; but there are still a number of things which the man on the track can do which will add to the life of the treated tie.

When ties are unloaded on the right of way, if they are not to be put in the track soon, it is better to pile them closely in piles of 50 or more, covering the top of the pile with 3 in. or more of dirt or cinders, as a protection from sparks and sun checking. If the ties happen to be freshly treated with zinc chloride or any water solution of a toxic salt, this suggestion will not apply as it is desirable to let the water season out before the tie is placed in track and in this event open piles should be used.

Use Care in Handling Treated Ties

In putting the ties in track by all means use tie tongs, at least don't allow the tie to be handled by sticking a pick into it, for all ties are not deeply penetrated by the preservative and the pick hole will be the avenue for the entrance of moisture and decay if the pick goes through the treated exterior of the tie.

You probably have ties of a number of kinds of wood to use, and it may be found that a certain wood gives better service on one part of the railroad than another; for instance, we find that in New Mexico and Arizona the western yellow pine will not check to the

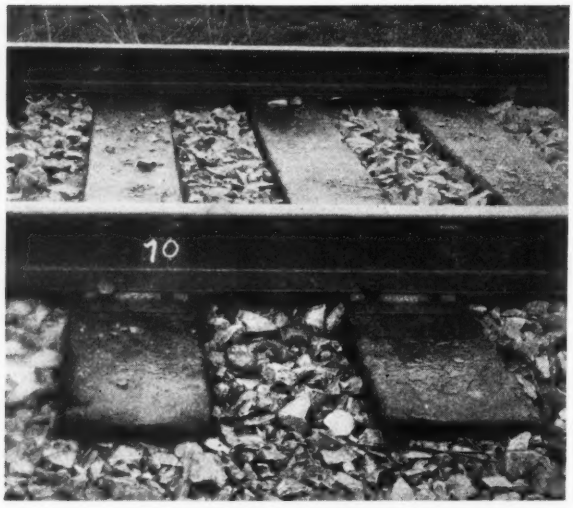
same extent—given the same treatment—as southern yellow pine in the same location. Likewise, we find that it pays to haul gum and oak from the south to New Mexico to use in curves over two degrees because they hold gage so much better than the soft woods.

The treated tie plug for treated ties has been mentioned. The plug should fit snugly yet must not split the tie even slightly. It should be driven to the bottom of the spike hole. I have seen section men splitting plugs from wood blocks or making them out of old boxes. The time required to make them makes the home-made article cost far more than the machine-made treated plug and it is not as effective.

One more suggestion and I have finished. When tie plates are applied to unplated treated ties or when a larger plate replaces a smaller one, which has cut into the tie sufficiently to make it necessary to adze the tie for the new plate, swab on hot creosote liberally to the adzed surface. It costs but a cent or two per tie and will pay big returns.

Discussion

The paper aroused active discussion, many of those present taking advantage of the opportunity to ask questions on topics suggested by Mr. Belcher's talk. E. D. Swift, engineer maintenance of way, Belt Railway of Chicago, inquired whether timber cut in the summer was more apt to decay or split than that cut in the winter, and also asked as to the merits of "anti-split" irons. Mr. Belcher replied that the Santa Fe used timber cut at all seasons of the year, most of it coming from the South. Where spring-cut timber has shown a tendency to decay more rapidly than that cut at other seasons it has been due to lack of care after cutting, as conditions in the spring are usually more



New Mexico Pine Ties Treated With Creosote-Petroleum Mixture, After 12 Years' Service

favorable to decay than at other times. He also said that Douglas fir ties received in the arid regions in the spring and early summer were apt to split, due to rapid seasoning. P. R. Hicks, secretary-manager of the American Wood Preservers' Association's Service Bureau, added that summer-cut timber was more apt to split on account of the heat. Mr. Belcher said that it is the practice of the Santa Fe to apply S-irons to gum ties from the south and to beech and maple ties from the north, as soon as the ties were made. Replying to another question, Mr. Belcher stated that the S-irons interfered with the branding of the ties and also prevented trimming off the ends before treatment to disclose defects in the timber that were not otherwise visible.

In reply to another question regarding the results obtained by the mixture treatment, Mr. Belcher said that the addition of petroleum insures better penetration of the sapwood and prevents checking both by the action of the oil on the fibres of the wood and by forming a protective coating over the surface of the tie.

In reply to other questions he said that the Santa Fe maintained three inspectors to examine ties removed

Showing the Result of Cutting Drain Box Plank After Treatment

from track to ascertain the causes of failure and also to standardize the foremen's ideas as to when ties should be replaced. Ties are not held for this inspection and the only ties inspected are those found when the inspector passes over the line. In addition, the maintenance of way councils on the different divisions hold meetings every 60 days which are attended by the roadmasters and foremen and by other division officers. Mr. Belcher has addressed such meetings on the proper handling of treated timber, illustrating his talk with lantern slides, to impress on the men the importance of this subject.

In regard to the comparative life of hewed and sawed ties, Mr. Belcher said that data were not conclusive, but that hewed gum ties seemed to give better results than sawed ties, probably due to the fact that the hewed ties contained more sapwood and so receive better penetration of preservatives. The same applies to pine ties, but not to so great an extent.

Answering a question of J. A. S. Redfield, assistant engineer of maintenance, Chicago & North Western, as to adzing and boring ties before treatment where various section of rail are used, Mr. Belcher stated that ties adzed and bored for 90-lb. and 110-lb. rail are kept in stock on the Santa Fe but that ties for lighter rail sections must be bored and adzed as needed. If necessary, ties bored for the heavier rail may be used for the lighter sections without plugging these holes, which are bored entirely through the ties, thus enabling the timber adjacent to the holes to be treated and preventing the accumulation of water in the interior of the tie.

R. N. Wade, engineer of maintenance of way, Chicago Rapid Transit Company, inquired if there would be economy in using treated ties containing a large percentage of sapwood instead of untreated long leaf yellow pine ties containing 90 per cent heart. Mr. Belcher replied that it was usually more economical

to use treated wood with a fairly large proportion of sapwood, citing some treated red gum ties with only a thin layer of sapwood which had a life of only 12 years, in contrast with some treated hewed gum ties, mostly sapwood, from which a life of 20 years had been obtained.

C. W. Baldridge, assistant engineer, Santa Fe, emphasized the fact that it was useless to treat ties unless they were cared for in the track and urged that the tie plates should be fastened to the ties independently of the rail to prevent destruction of the tie by sawing and grinding, calling attention to the discussion of this feature by G. J. Ray, chief engineer of the Delaware, Lackawanna & Western, in the January issue of *Railway Engineering and Maintenance*.

In reply to a question by Mr. Swift as to the relative merits of creosote and zinc treatments, Mr. Belcher said that both are standard treatments and the choice depends on a number of conditions, prominent among which are the climate and also the extent to which mechanical wear determines the life of the tie. Where ties are worn out before failing from decay if creosoted, it might be better to treat them with zinc. The experience of the Santa Fe had caused it to prefer creosote, since zinc ties often check badly in the arid regions of Arizona and New Mexico.

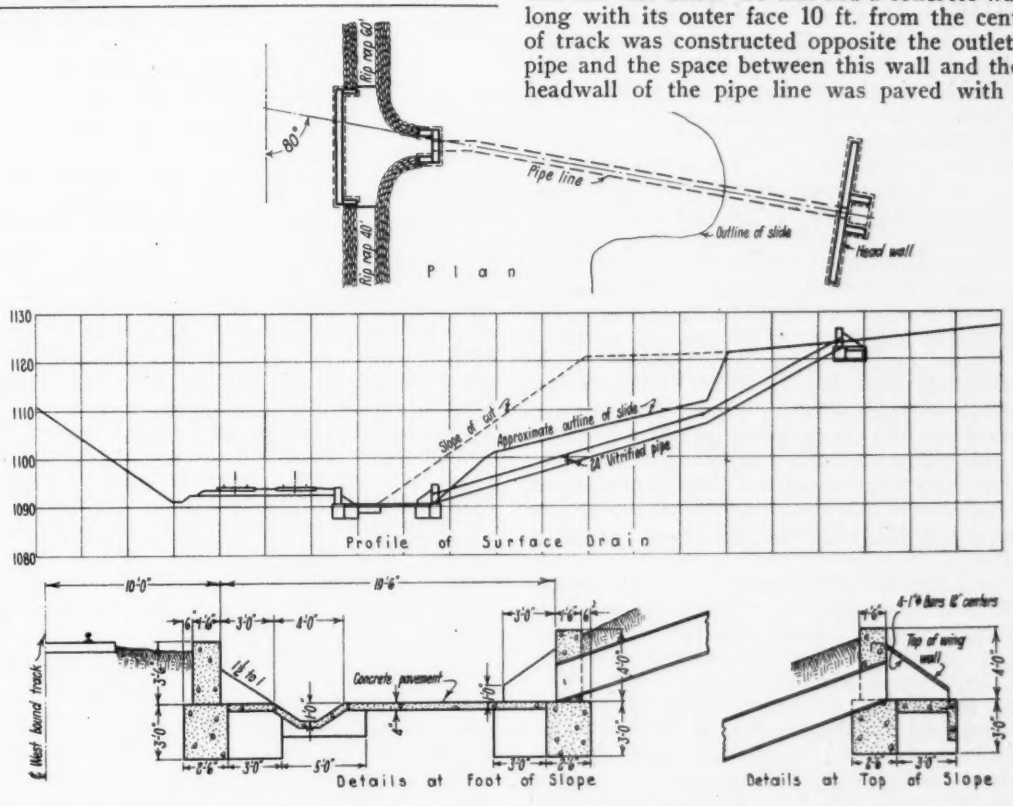
Replying to a question by F. W. Hillman, assistant engineer maintenance, Chicago & North Western, as to the characteristics of the petroleum used in the mixed treatment, Mr. Belcher said that fuel or residual oil having an asphalt base was used. It has been found that oil with such a base mixes better with the creosote and also forms a more lasting coating on the ties. No trouble is experienced with sludge in the working tanks when the oil is heated and run into the hot creosote, but if the oil is cold when mixed it sometimes forms a sludge.

Pipe Line Stops Slide in Cut

THE development of a slide in a cut on a new line of the Big Four south of Bellefontaine, Ohio, caused by surface water from cross drainage, led to the construction of a small but complete drainage system to remove the water before it entered the soil. The cut in question is 33 ft. deep at the point of the slide and carries a two-track main line forming a part of a relocation for the purpose of revising grades. The material in the cut is clay, containing considerable sand and gravel and, as seen in the photograph, is susceptible to wash. At the point where the slide occurred, the cut intercepts cross drainage which takes the run-off from an area of 11½ acres which, in the absence of a surface ditch, had to run into the cut, carrying large quantities of dirt with it.

A surface ditch would have required excessive grading so it was decided to admit the water into the cut and dispose of it through the side ditch. A trench was therefore dug to solid material under the soft clay in the slide and a 24-in. vitrified pipe with cemented joints was laid up the slope to a concrete headwall constructed as a dam across the drainage. This wall was reinforced with two wing walls on the upstream side, the opening being protected from debris by a grid consisting of four one-inch bars imbedded in a concrete apron and in the headwall. A short headwall, also with wing walls, was constructed at the foot of the pipe line, the face of this wall being set 29½ ft. away from the center line of the nearest track.

Owing to the steep slope of the pipe line, the water will leave the pipes at a very high velocity which must be dissipated before the water can be conducted into the side ditch. To this end a concrete wall 27 ft. long with its outer face 10 ft. from the center line of track was constructed opposite the outlet of the pipe and the space between this wall and the lower headwall of the pipe line was paved with a 4-in.



How the Cross Drainage Was Disposed of

The Slide in the Cut

concrete slab, to form a surge basin. The ditch for a distance of 60 ft. in one direction and 40 ft. in the other, was riprapped, the riprap also being extended on the upper side to a curved connection with the outlet of the pipe.

This plan was developed by F. N. Johnson, resident engineer, Cleveland, Cincinnati, Chicago & St. Louis, West Liberty, Ohio, under the direction of W. S. Burnett, chief engineer of construction.

Foremen Receive Prizes For Safety Records

A TOTAL of $12,380 was recently distributed among foremen in the maintenance of way department of the Southern Pacific, Texas and Louisiana lines, in the form of prizes based on the safety records of their gangs during 1926. This represents the outcome of a plan established in 1925 under which all foremen in the maintenance of way, mechanicals and stores departments and in station service, receive prizes after the close of each year, in proportion to the number of man-hours worked by their gangs without a reportable accident, i. e., one causing a man to be incapacitated for more than 3 days during the 10 days immediately following an injury. A minimum award of $15 is made to every foreman in charge of a gang working 20,000 man-hours or less during the calendar year without a single reportable accident. For foremen working larger gangs the prizes are increased $15 for each 40,000 additional man-hours worked by their gangs without accidents, the maximum prize being $105.

The record for the maintenance of way department during the past shows that out of 730 foremen eligible for prizes, 633 received awards and that of these, 563 received the maximum awards for which they were eligible. The average prize award made was $19.56. Excluding the New Orleans and Houston terminal divisions and the DeRidder division, on which the number of foremen employed is relatively small, the best showing was made by the El Paso and Austin divisions. On the former all of the 103 foremen received prizes, while 92, or 89.3 per cent, received the maximum awards for which they were eligible. On the Austin division 71 out of 77 foremen received prizes and all of these foremen received the maximum awards for which they were eligible. In other words, 92.3 per cent of the foremen made perfect records.

Plenty of Spring In This Pier Fender

IN THE design and construction of pier fenders at channel openings in navigable streams the primary requisite is a maximum of protection of the bridge against damage resulting from collisions with vessels using the stream. Another important consideration is that such a structure be of simple design, embodying the least amount of framing in construction. A design of pier fender in which these two features are embodied to an unusual degree has been developed by the Central Railroad of New Jersey, and while its most outstanding application has been for the protection of the four vertical lift spans of the new four-track bridge across Newark Bay, it is equally applicable to structures of far less importance.

The principle underlying this design, which is illustrated in the drawing here shown, is that of a flexible structure in which the resistance it offers to the floating mass brought in contact with it, increases as it is deflected or pushed back. Whereas most pier fenders consist simply of a timber wall of which the primary feature is one or more rows of piles, this wall consists of two elements, a wall with one row of piles and a series of pile clusters or dolphins. The wall is anchored to the dolphins by cables but is separated from them by a clear space of about 7 in., so that the wall must be pushed back by that amount before any resistance is offered by the dolphins.

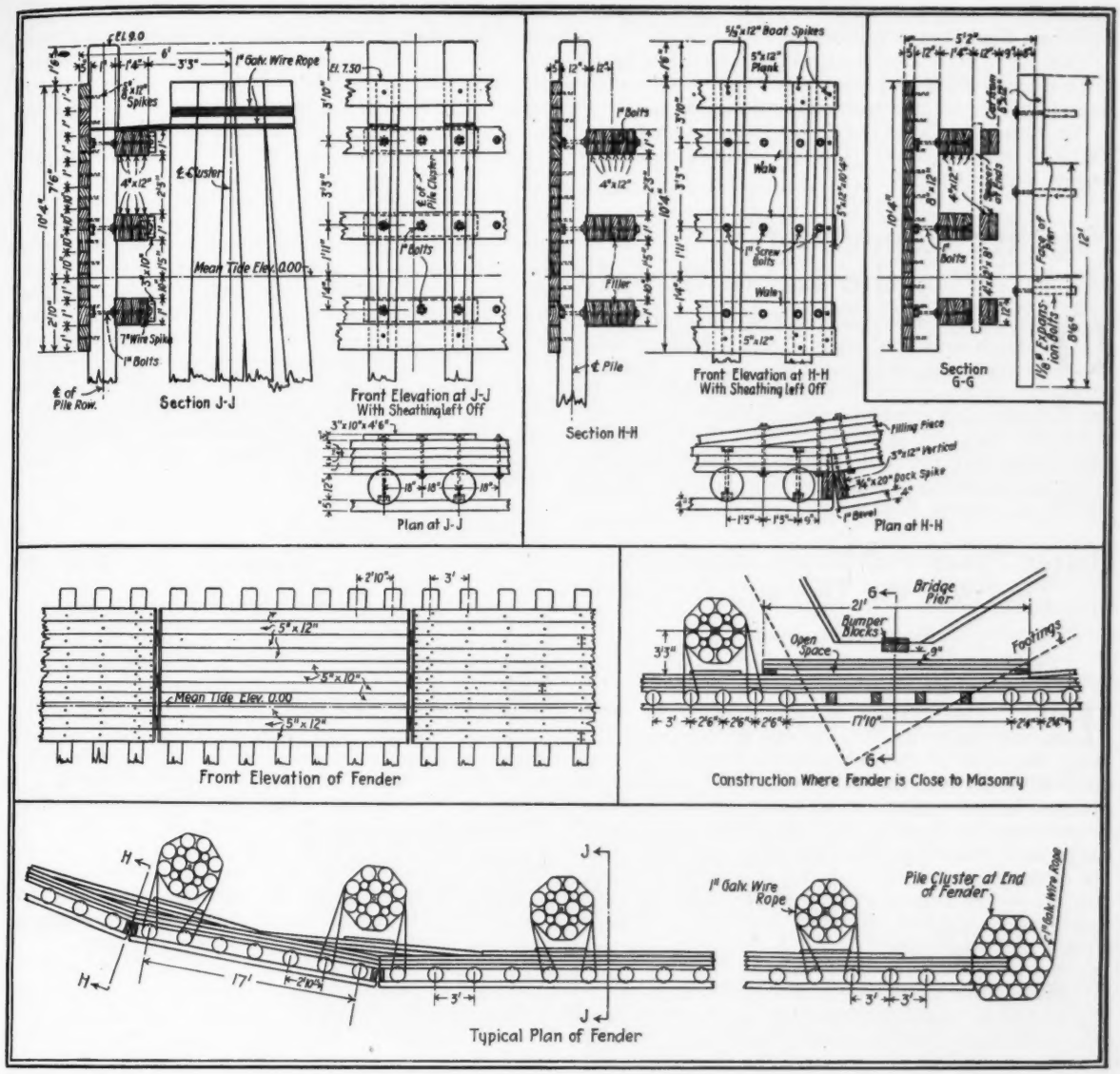
How the Wall Is Built

The wall consists of piles with a butt diameter of 14 in., spaced 2 ft. 10 in. to 3 ft. center to center. These piles are sized on one side to receive a horizontal sheathing of 5-in. by 12-in. and 5-in. by 10-in. plank for a height of 10 ft. 4 in., beginning 18 in. from the top of the pile. On the rear side the piles are notched to receive three lines of waling, these notches being cut to give a finished thickness of the pile of 12 in. between the bearing faces of the sheathing and waling. The planks are nailed to the piles with one ⅝-in. by 12-in. spike at each intermediate pile and two at the piles nearest the end of each plank.

The wales consist of four thicknesses of 4-in. by 12-in. plank set edgewise and secured to each pile by a 1-in. bolt and held together between piles by an additional bolt. Opposite each dolphin the wales are backed with a 3-in. by 10-in. plank 4½ ft. long, to take the wear at the point where the wale is brought into contact with the dolphin. This plank is attached by 7-in. spikes so that it may be readily replaced when it becomes worn.

Four Piles in Each Cluster Driven Butt Down

The dolphins consist of 16 piles with 14-in. butts, four piles being inverted with 8-in. points at the top as shown in the plan. These clusters are wrapped with four winds of 1-in. galvanized wire rope, in addition to which they are secured to the wall by a loop of wire rope around the two nearest piles in the


Section J-J
Front Elevation at J-J With Sheathing Left Off
Plan at J-J
Section H-H
Front Elevation at H-H With Sheathing Left Off
Plan at H-H
Section G-G
Front Elevation of Fender
Construction Where Fender is Close to Masonry
Typical Plan of Fender

Details of the Fender Construction

wall. Special pile clusters are provided at the ends of the wall where, as shown in the drawing, the piles are so driven as to enclose the ends of the wales.

Special construction details are introduced at the angles in the wall, particular pains being taken to insure continuity without introducing a rigidity of construction that would reduce the flexibility of the wall. This feature is also shown in the illustration where it is seen that three of the planks of each wale are cut off to make a tight butt joint at the intersection angle. However, the wales are made continuous across the joints by backing them with planks bevelled to fit the angle of the wall. As these angles in the wall are made halfway between the adjacent piles, each leg of the wall is finished with a 5-in. by 12-in. vertical timber between the sheathing and the waling, the sheathing planks being cut off square with the outer face of the vertical timber so as to leave a wedge-shaped opening extending to the back of the waling. This is done to avoid excessive stiffness of the wall and to insure that compressive stresses are not set up in the sheathing in the event that the angle of the wall is flattened when the wall is deflected under the pressure of floating equipment.

Special Construction Where Wall Is Close to Pier

Another special construction is provided at points where the fender wall must be placed so close to a pier that there is no room for a pile cluster behind it and where the pier footing precludes the driving of wall piles. Here 8-in. by 12-in. posts are substituted for the piles in the wall and a vertical bumping block composed of two or more timbers is bolted against the face of the pier. The wall is set out far enough from the pier so that the wales do not come in contact with the bumping timber until the wall has been pushed back 9 in., but further cushioning is provided by reinforcing the wales with auxiliary wales of two 4-in. by 12-in. planks 18½ to 21 ft. long which are bolted to the standard wales only at each end through a spacing timber which provides a clearance of 4 in. between the inner and outer wales. This means that after the wall has been deflected 9 in. which brings the outer wale against the bumping

timber, this outer wale must be deflected 4 in. more before all flexibility is eliminated.

This form of fender construction has been found to be easy to build and has proved thoroughly effective in the service for which it is designed.

We are indebted for the above information to J. J. Yates, bridge engineer, Central Railroad of New Jersey, Jersey City, N. J.

Further Reports on the Labor Supply

ONE of the many outstanding features of the March or labor-saving issue of *Railway Engineering and Maintenance* was the resumé of current labor conditions throughout the United States and Canada as reported by railway officers on different railroads. In addition to the reports there presented two others were received too late for publication and owing to the pertinent supplementary facts which they contain we present them below.

Better Track and Power Equipment Decrease the Demand for Labor

By BERNARD BLUM

Engineer Maintenance of Way, Northern Pacific, St. Paul, Minn.

THERE was no labor shortage through the northwestern states in 1926. The economic conditions along the lines of the northern transcontinental railroads have not been satisfactory at other than isolated points. In many districts the poor crop returns, due to protracted hot weather and lack of moisture at critical periods, resulted in the release of considerable labor for construction purposes. While the Northern Pacific has undertaken a normal amount of improvement work there has been a lack of heavy construction items to absorb the casual laborers and I think this has been true with the other northern railroads.

Owing to the open winter during the first part of 1926, a large amount of roadway improvement work was undertaken and completed before spring. This gave us a longer period in which to carry out our work and enabled us to do a great deal more with the same number of employees. It also stabilized the labor market and permitted the holding of efficient workers.

At the present time not a great deal of railroad construction is being undertaken in the northwest other than the work on the Great Northern tunnel through the Cascade Mountains. The present winter season has been a severe one throughout the northwest. Winter started in very early and was very cold with few interruptions. The Northern Pacific in conjunction with the War department has been engaged in a heavy riprap program along the Missouri river. Road construction has probably been the largest single construction factor in the northwest for several years and the cold weather precluded the continuation of that work. On the Coast lines ballast and relay work had started. The building construction in the past year and at the present time is light and the lumber movement, which is a barometer of building activities, while showing a slight improvement recently, has not been very active.

There has been and is at the present time plenty of labor available. During recent years the lack of heavy construction and development work has resulted in more efficient labor and to a large extent our extra gangs have been recruited from local residents of both town and country. It is no unusual thing to see 20 or 30 automobiles lined up along the right-of-way where an extra gang is working. With the present rate of wages, 39 cents per hour for common labor on the track, we have been able to attract first class white labor, whereas previously we were compelled to take what foreign gangs could be obtained.

For some years we have been rapidly improving the character of our tracks, bridges and buildings and are now realizing a satisfactory return in the form of deceased labor requirements for ordinary maintenance. A considerable number of our section, bridge and building gangs have been reduced. We have also adopted a systematic program of purchasing labor-saving equipment and devices such as locomotive cranes, ditchers, power tie tamping machines, weed destroyers, rail relaying machines, etc., have increased the efficiency of labor and have attracted to us a better class by reason of the resultant decrease in the arduous character of track work.

Plenty of Labor for Work on the Wabash

By R. H. HOWARD

Chief Engineer, Wabash, St. Louis, Mo.

THE only shortage of labor we experienced during 1926 was in the vicinity of large cities where manufacturing plants were working full force. Some railroads in our vicinity turned over some of their heavy maintenance work as well as construction projects to contractors because they were hampered by heavy work in large cities and inclement weather. There is every indication that activity in hard road building will be just as brisk as last year, and our industrial agent advises that there is prospect of considerable new industrial development along our line besides the usual amount of apartment and industrial building construction in the St. Louis territory.

With all of the construction work in progress there seems to be plenty of common labor available as indicated by our experience in the construction of a new elevator at North Kansas City where hundreds of men applied for employment daily on both the track and building construction.

The character of labor has not changed any during the past two or three years as there is sufficient native labor to take care of our requirements and the negro is still being used in this territory on heavy maintenance work such as rail laying and ballast work in lieu of Mexicans and Greeks.

Labor-saving devices have been in use for only four or five years in this territory and such use without a material increase in forces has resulted in a decided improvement of the properties, as a great many of the railroads in this vicinity have been carrying out extremely heavy maintenance programs during this period. In all probability when the railroads have disposed of all their deferred maintenance they will be able to reduce their demands for labor through the use of labor-saving devices such as ditchers, ditcher-spreaders, mowing machines, power tampers, paint sprayers and joint oilers.

RAILROAD CONSTRUCTION 25 YEARS AGO.—At the present time not less than 7,984 miles of new railroad are already under contract or actually under construction.—*Railway Age*, March 21, 1902.

Building A Second Track In Short Time

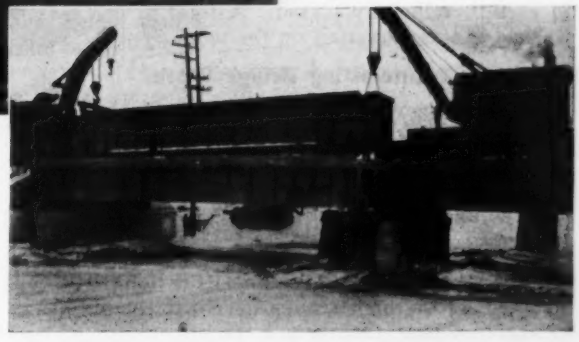
Division Forces on Pennsylvania Complete Six-Mile Project Including Two Bridges in 52 Days' Time

By R. W. E. BOWLER
Division Engineer, Pennsylvania, Toledo, Ohio

THE VERY short time required for the completion of the latest section of second-track work on the Toledo division of the Pennsylvania between Woodville, Ohio, and Gibsonburg, demonstrates clearly what can be done by careful planning and an adequate construction plant to bring such work to an early conclusion, especially when it is started late in the year. This project, which consisted of about 100,000 cu. yd. of grading, two bridges, six miles of main track, about five miles of supporting sidings, with additional water facilities and a track scale, was authorized on October 13, 1926. On October 15 the work was turned over to the division organization to carry out without interference with a daily traffic of about 35 freight trains and 12 passenger trains over the single-track line.

Above — Considerable Grading Was Done With Teams

To the Left and Below—The Portage River Bridge



Had to Complete Work Before Freezing Weather

On account of the fact that the tracks were to be ballasted with washed gravel which it is impractical to handle during the winter, it was necessary to prosecute the work at such a rate as to get the tracks laid and properly ballasted for main-track service by December 15 if the operating department were to have the use of them much before May 1, 1927. This called for prompt and active work on all features of the project during daylight hours, with careful planning each night to avoid any lost motion. Such a program was carried out continuously, including all Sundays and holidays, until the second main track was in service.

When the project was authorized it was necessary to place in the field at once an engineering force large enough to get out the necessary bridge masonary plans, make property surveys and prepare plans so that property could be had to start grading on November 1. There were 20 separate parcels to be surveyed and plotted. Municipal legislation had to be secured for the vacation of streets and alleys in both Woodville and Gibsonburg and for crossing streets and roads, including one "superhighway." The work was so arranged that the various parcels of property were purchased in the order in which they were required for the grading and within 10 days sufficient property had been purchased to permit this work to proceed.

Between October 15 and 31 the contractor, with the aid of the division forces, had purchased the necessary property for borrow pits, constructed the necessary sidings for them and completed housing facilities at both ends and at about the middle of the work to accommodate a total of 300 track men, 60 grading men, 25 bridge men and stable facilities for 80 horses. These camps were so arranged that the various class of labor could be segregated and every man on the work had a comfortable bed, and received adequate, wholesome food, well prepared and served. No men were moved on the work until there were proper facilities for their comfort and it is worthy of note that no labor trouble of any sort was experienced, notwithstanding the long hours of concentrated work, and further that there was not a single serious accident to men on duty during the construction of the second track.

Five Grading Outfits on the Work

On November 1, after the engineering work and real estate purchases had been sufficiently advanced, grading work was started simultaneously at five locations, as follows:

(1) Gibsonburg to M. P. 65—1.1 miles
One 1¼-cu. yd. revolving electric Marion shovel
Sixteen 2-cu. yd. dump cars

Two Plymouth gasoline locomotives
Moving earth from a borrow pit near the center of a stretch of fill.

(2) M. P. 65 to Sugar Creek—1 mile
One Western elevating grader pulled by a caterpillar tractor
Twenty 1½-cu. yd. Western dump wagons
Moving earth from a borrow near the north end of a stretch of fill.

(3) Rock cut north of Sugar Creek
One ¾-cu. yd. revolving Osgood shovel
Dynamite gang
Removing 1600 cu. yd. of limestone rock by drilling, shooting and casting back.

(4) Sugar Creek to Portage River—2.8 miles
Two work trains with fifteen 12-cu. yd. Western dump cars each
One ¾-cu. yd. revolving Marion shovel
Moving earth from a borrow near the north end of stretch of fill.

(5) Portage River to Woodville Block Station—1.1 miles
One Western elevating grader pulled by a caterpillar tractor
Ten 1½-cu. yd. Western dump wagons
Placing earth in a fill from side borrow adjacent to the right-of-way.

With these five outfits working during the daylight hours, track work was started close behind the grading on November 6 and by November 10 sufficient track was built to furnish refuge for the work trains and to begin final ballasting.

The standard ballast section required 12 in. of raw gravel and 11 in. of washed gravel. In order to avoid a congestion of ballast cars on the line and the possibility of raw gravel freezing in transit, as well as to save time and expense, the sub-ballast was obtained from stone quarries in the vicinity and applied by dump cars on top of the fill before the ties were laid. This not only saved the cost of raising the tracks through the 12-in. blanket of sub-ballast, but also eliminated the handling of about 500 cars of ballast in transportation service cars which would have been very slow and troublesome, particularly on account of the limited siding facilities in the vicinity. The track construction on this section consisted of 100-lb. P. S. rail, with 20 ties to a 39-ft. rail, fully plated. A total of 655 cars of washed gravel was used on the work.

Interesting Bridge Work

The bridge work consisted of replacing single track open deck bridges over Sugar creek north of Gibsonburg, and over the Portage river at Woodville with double-track, ballasted-floor bridges, including the necessary alterations and extensions of the masonry. As the superstructure for the Sugar Creek bridge could not be obtained before January 1, a temporary pile trestle 110 ft. long was constructed across this stream adjacent to the old bridge to accommodate the second track.

Because the bed of the Portage river is rock and on account of possible high water and ice, a temporary wooden trestle could not be considered for this location. Therefore, it was necessary to complete the permanent work before the second track could be placed in service. The new bridge consists of two 77-ft. 6-in. deck girder spans, replacing one span of 80 ft. and one of 75 ft. As the new spans were not of the same length as the old, thus requiring a new location for the center pier, it was necessary to place the existing spans on falsework, remove the old stone pier and construct a new concrete pier in the required location to accommodate the new spans.

The masonry work was started as soon as plans could be prepared, and notwithstanding several days' delay on account of high water, the entire masonry was completed December 1, 25 days after the work was started. Miami cement was used in order to obtain full strength concrete in seven days.

How the Steel Was Erected

The superstructure under the existing track was replaced with new spans and reinforced concrete slab floors were provided for both tracks. The new spans were unloaded with two wreck derricks, those for the second track being placed in final location and those for the existing track on falsework alongside. The reinforced concrete floors were then constructed, using Lumnite cement to obtain the required strength in the shortest possible time. They were completed on December 15 and the bridge was placed in service December 22. At that time the old spans were lifted out and the new spans, with slab floors, were lifted into place.

The work at this bridge was further complicated on account of its being located at one of the points where the new track crossed the line of the existing track, making it necessary to shift the old superstructure about four feet and throw 1600 ft. of track, all under traffic, before the superstructure for the second track could be placed.

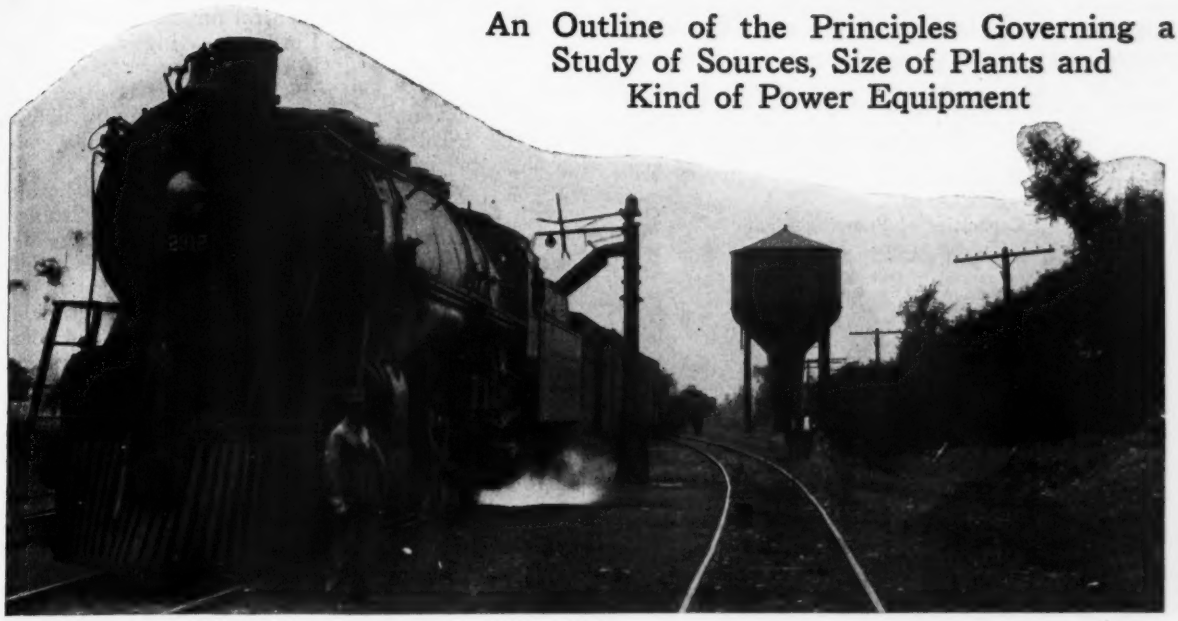
By a well planned marshalling of materials and men during the entire construction period, the entire main track except 1400 ft. north and south of the Portage river bridge was built and ready for service on December 5 and the portion between Gibsonburg and south of the Portage river bridge was placed in service on that date. On December 22, one month and 22 days after the work was started, the entire second main track, which crossed the line of the existing track twice, was in service, including the bridges at Portage river and at Sugar creek.

This work was under the direct charge of C. R. Carter, district manager, and W. E. Walsh, superintendent, for the contractors, the Ferguson & Edmondson Company, Pittsburgh, Pa., and under the direction of the writer, assisted by P. D. Miller, assistant division engineer, and G. A. Sawyer, engineer in charge, for the Pennsylvania.

Where a Railroad Occupies Both Sides of the Canyon—Double Track Line of the Denver & Rio Grande Western in the Eagle River Canyon Near Gilman, Colo.

How to Select Water Supplies*

An Outline of the Principles Governing a Study of Sources, Size of Plants and Kind of Power Equipment



THE supply, if possible within economical limits, should be sufficient so that the total amount likely to be required during the average volume of business in 24 hours can be drawn from the source in 7 hours at terminal stations and in 4 hours at intermediate stations. The quality of water should invariably be investigated when selecting a supply. Such investigations should be governed by the use for which the water is obtained. Where the supply is not required for drinking, the examination may be confined to the chemical constituents. Where drinking water is contemplated, it should be examined from a sanitary standpoint as well. Suitability of water for boiler feed depends not only upon the presence of mineral in suspension or solution that will cause sedimentation or incrustation in pipe lines and boilers, but also upon the presence of dissolved gases or other matter, organic or mineral, that will cause or promote foaming or corrosion. The expense and practicability of treatment should be considered, where naturally suitable water is not readily available. Acid water should never be used without treatment. In general, whenever the total incrusting matter exceeds six grains per U. S. gallon, some form of treatment is desirable. However, this depends upon the quantity used, the character of the incrusting matter and the probable effect of the water when used in connection with other supplies.

The Source of Supply

Where water of suitable quality and in sufficient quantity can be purchased at a reasonable cost, it is recommended above all other sources. Springs should be carefully investigated to determine their yield during all seasons of the year. The possibility or probability of their pollution and the quantity of water likely to be required in the future should be considered. If the daily flow of springs is not largely in excess of the daily quantity required, an impounding reservoir should be constructed.

Lakes, natural ponds, creeks, or rivers require special investigation in each case. The points to be considered are quantity, quality—with regard to chemical impurities and the amount of sediment carried—future pollution and riparian rights.

In localities where the surface streams have intermittent flow, or where the water of these streams does not permit of treatment, and where the underground supply is insufficient or untreatable, if there is sufficient rainfall to produce an adequate run-off, resort may be had to impounding reservoirs. Wherever possible, such reservoirs should be located at an elevation sufficiently above the point of use to obtain a gravity supply. Before constructing an impounding reservoir, very careful consideration should be given to the following particulars: Rainfall records, stream gaging records, average temperature and wind velocity, humidity, character of the proposed site including size, shape and nature of material, which may affect the seepage, extent of drainage area, kind of soil and nature of vegetation on the drainage area which affect the run-off.

In unproved ground, dug well construction should be proceded by test borings to reveal the strata to be penetrated. The character of the strata largely determines the size of the well and the kind of construction necessary.

Artesian wells, where obtainable, are a satisfactory source; however, their yield is liable to constant decrease and final cessation. Deep wells that require pumping usually cost more for maintenance and operation than other sources and are generally, for that reason, undesirable but their disadvantages are often compensated by the excellence and absence of pollution of the water yielded by them. Where the daily demand is relatively small, or where the water must be secured from underlying rock strata, the ordinary drilled well is satisfactory. However, when larger yields are required and may be obtained from water

*Abstracted from the report of the Committee on Water Service, presented at the convention of the American Railway Engineering Association on March 9, 1927.

bearing sands or gravel, the larger gravel walled wells should be used.

Consideration should always be given to the possibility of securing a gravity supply, even though it may require pipe lines of considerable length. If the annual fixed charges on the gravity plant are less than the cost of pumping from a nearby source, the gravity plant should be adopted.

Pumping Plants

The capacity of the plant should be in accordance with the table:

Capacities of Pumping Plants

Quantity per 24 hours, in gallons	Terminal Stations: Time pump to run in 24 hours	Terminal Stations: Gallons per Minute	Intermediate Stations: Time pump to run in 24 hours	Intermediate Stations: Gallons per Minute
2,000,000	20 hours	1666	20 hours	1666
1,750,000	20 hours	1458	20 hours	1458
1,500,000	20 hours	1250	20 hours	1250
1,250,000	20 hours	1042	20 hours	1042
1,000,000	20 hours	833	20 hours	833
900,000	20 hours	733	20 hours	733
800,000	20 hours	666	20 hours	666
700,000	20 hours	583	20 hours	583
600,000	20 hours	500	10 hours	1000
500,000	7 hours	1189	10 hours	833
450,000	7 hours	1071	10 hours	750
400,000	7 hours	928	10 hours	666
350,000	7 hours	838	10 hours	583
300,000	7 hours	714	10 hours	500
250,000	7 hours	595	4 hours	1041
200,000	7 hours	476	4 hours	833
150,000	7 hours	357	4 hours	625
100,000	7 hours	238	4 hours	416
50,000	7 hours	119	4 hours	208
25,000	7 hours	60	4 hours	104

The static head should be obtained and the friction head determined in accordance with well-known formulae or from charts making proper allowance for the aging of the piping system. Before selecting the type of equipment and kind of power to be used, comparative estimates of annual operating costs, including interest on the investment, depreciation, taxes and insurance, should be made and the most economical plant determined.

At points where it is necessary to maintain a steam plant for other purposes, as at engine terminals, or where track pans are maintained in cold climates, steam plants will usually prove most economical.

The engine horsepower will be

$$\frac{\text{Gallons per minute} \times (\text{static head plus friction head in feet})}{3960}$$

The medium pressure oil engine, or so-called semi-Diesel type, has now been brought to a state of perfection where it is generally the most economical and practicable type of power unit for all ordinary railroad water service installations. By reason of simplicity of operation, small floor space required, convenience in storing and handling the fuel, usually lower cost of installation, and low attendance cost, the oil engine has proven most desirable for all intermittent power service.

The crude oil distillates of 26 deg. Baumé and over are used to advantage in the semi-Diesel crude oil burning engine. To avoid trouble, oil engines should not be operated in excess of their rated horsepower. A properly designed engine of the semi-Diesel type should operate on 0.6 lb. of fuel per brake horsepower hour with a consumption of not over one gallon of cylinder oil per 400 rated hp. hr. in the sizes of engines up to 25 hp. and one gallon per 800 hp. hr. in the larger sizes.

All gases from petroleum oils are highly explosive when mixed with the atmosphere and are heavier than air. For this reason, great care should be used to see that there are no depressions which may collect these vapors and cause an explosion. Oil engine houses should be ventilated at the floor line and wherever possible the floor should be above the ground.

Electric Plants

The use of automatic control for electrically operated pumps has resulted in large saving in operating costs in many cases. If reliable electric current is available and at a reasonable price, it is often the part of economy to replace steam pumping plants with electrically operated pumps automatically controlled, particularly where attendants may be released. Automatic control is especially applicable when the pumping station is located at a distance from the storage tank, terminal, or point where the water is used. The automatic starter is easily and conveniently controlled from any remote point by means of a pilot or actuating device. An experienced attendant is not required for its operation and complete protection is afforded the motor in starting and stopping.

Remote control is usually by means of push button, pressure regulator or float switch. Float switches are usually used in connection with automatic starters on water tank service.

Direct Current

When considering direct current motors and starters, the mechanical structure of the pump must be taken into consideration. For a reciprocating type of pump, a motor capable of considerable starting torque must be used and a starter which will enable that motor to develop the required starting torque. This calls for a compound-wound motor, which will have the advantage of the shunt field to stabilize the speed with full load or no load. The starter should be of the time limit type in order to be positive of a proper start, even though the friction of the pistons or bearings is greater than usual.

If the pump is of the centrifugal type, which requires a very light starting torque, a shunt motor can be used and either a time limit, current or counter e.m.f. limit type of starter employed. The time limit or counter e.m.f. is best for the smaller sizes up to 10 hp., while the current limit type on the larger sizes seems advisable.

Alternating Current

When considering alternating current similar limitations must be kept in mind. With a reciprocating type of pump the use of a slip ring motor with time limit secondary type of starter is advisable. This may not be rigidly followed, but if any other type of motor is used the question of starting torque must be very carefully considered.

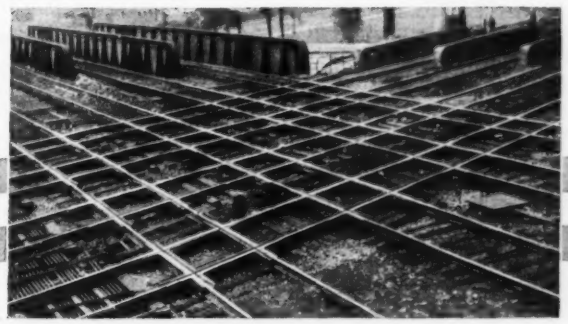
If a squirrel-cage motor is thrown directly across the line and has a high resistance motor, it will develop more starting torque than when running, but if the motor is of such a size that it may not be possible to throw it across the line, it will be necessary to use either an auto transformer or compensator type or a primary resistance type of starter.

When considering centrifugal pumps, a squirrel cage motor can be used with an auto transformer or compensator type of starter or with the primary resistor type, because the starting torque of the pump is usually well within the limits of the starting torque of the motor, with the reduced voltage.

On any automatic starter with two-wire control low-voltage release is provided. Overload protection can be supplied if desired. The control equipment should be located within plain view from the motor and as close to it as conditions will permit.

Are Foundations Under Crossings Worth While*

A Detailed Report on Various Types of Construction Subjected to Test



Proposed Plan for Standard Concrete Slab to Serve as a Ballast Support

By O. F. HARTING
Assistant Chief Engineer, Terminal Railroad Association of St. Louis

THE EARLIEST installation of a foundation under the intersection of two or more railroad tracks of which we have any record was made in 1916, or about 11 years ago. To date no standard type or design of crossing foundation has been developed and it was for that purpose that the American Railway Engineering Association last year appointed a sub-committee to study the design and effect of crossing foundations. This sub-committee, of which I am chairman, sent a questionnaire to 182 railroads asking for specific information on this subject, to which 62 replies were received, among which only 18 railroads had actually tried some form of foundation.

None of the installations, with a few exceptions, has been in place long enough to warrant the drawing of any definite deductions. On these 18 roads, 6 structural steel foundations had been installed on 3 railroads, with the first installation in 1918; 48 wooden pile foundations were in place on 3 railroads with the first installation in 1921; 20 plain concrete foundations had been built on 4 railroads, the first of which was installed in 1916, and 92 reinforced concrete foundations have been installed, with the first installation in 1916.

Types of Foundations

The structural steel type consists of a pair of 7-in. or 9-in. channels spaced about 13 in. back to back, filled in solidly with short wooden blocks and an occasional diaphragm consisting of a short "I" beam. Eighteen-inch plates are fastened to the top and bottom of the channels, giving in effect a beam 18 in. wide by 7 in. or 9 in. deep. One beam of this section is placed under each rail of the crossing; one set of beams running continuously through the crossing in the direction of heavy traffic railroad, the other set of beams being fabricated in three lengths and held in proper position by means of steel angles. This structural steel foundation is placed on top of 10 in. or more of crushed rock or other suitable ballast. The railroad crossing is fastened directly to the steel beams by means of rail clips and bolts, no cross ties being used.

Pile foundations are generally employed where filled ground or a marsh is encountered. This type consists of a heavy timber frame work resting on piles, creosoted timber piles being generally used. One pile is driven directly under each frog or rail intersection of the crossing and the heavy timber frame work is fastened to the tops of the piles, framed to fit the angular shape of the crossing. The railroad crossing is then spiked directly to the timber frame work, eliminating the use of crossing ties. In this type of foundation, the timbers act as beams or stringers spanning from pile to pile, thus transferring the loads directly to the piles. A variation of this type consists of driving piles as closely together as practicable over the entire area of the crossing, the tops of the piles being driven to sub-grade and covered with from 12 in. to 15 in. of ballast.

Concrete Slab Foundations

The plain concrete type is made by pouring a concrete slab or bed under the crossing, establishing its top at sub-grade, placing ballast thereon and then installing the railroad crossing with crossing ties in the customary way. The item of greatest importance with a foundation of this kind is the thickness of the concrete and that is where we find much variation. On the four railroads using this type, the thickness of the concrete varies from 10 in. to 30 in. Some of this variation, of course, may be explained by a difference in the amount and weight of traffic, or by a difference in soil conditions, but it would hardly seem reasonable that the conditions vary sufficiently to warrant a 10-in. thickness in one place and a 30-in. thickness in another. The railroads are also at variance in the amount of ballast used on this type of foundation, the depth ranging from 4 in. to 14 in.

The reinforced concrete type of foundation is virtually the same as the plain concrete, except that the slab is reinforced with steel rods. The slab may be poured in place, or precast and hauled to the site as a unit. In some instances a cushion of sand or cinders 2 in. to 12 in. is first placed, then the ballast

*Abstracted from a paper presented before the Maintenance of Way Club of Chicago on March 17, 1927.

and crossing ties and finally the railroad crossing itself. Some railroads dispense with the cushion and place the slab directly on the ground. To facilitate handling, "U"-bolts are inserted when the slabs are precast.

Design of Slab Is Important

The thickness of concrete and the amount of reinforcing steel are of paramount importance in a foundation of this kind. Our records show that the thickness of the concrete employed varies from a minimum of 12 in. to a maximum of 20 in. and that the reinforcing steel ranges from two layers of ½ in. square rods spaced 6 in. center to center, running at right angles to each other in both the top and bottom parts of the slab, to ¾ in. square rods spaced 9 in. center to center and similarly arranged. This represents a variation from approximately 0.6 per cent to 1.2 per cent of steel reinforcement. In my opinion the slab should be 12 in. to 15 in. thick with preference for the latter.

Some roads place a cushion of sand or cinders before installing the slabs and I think this is highly desirable, especially in the case of precast slabs, as the cushion tends to give the concrete an even bearing, thereby minimizing the detrimental effects of unevenness in the excavation. In the case of poured-in-place slabs I do not consider a cushion so important because the concrete will shape itself to any irregular surface of the ground.

I see no decided advantage between the precast and poured-in-place concrete foundations; the facility for handling the slabs, frequency of traffic and other conditions of similar nature must determine the type to be used. If the railroad crossing is on new line work and can be kept out of service long enough to let the concrete cure properly, I would pour the slab in place. If, on the other hand, the crossing is already in use, and cannot be taken out of service more than a few hours at a time the precast slab is better, since to raise the railroad crossing, support it on falsework and build or pour a reinforced concrete foundation under it, is an expensive and awkward procedure. The precast slabs can be made and cured in a material yard and stored there until ready for use; a standard one-size slab can be used for all angles of crossings above 40 deg. If many are made at one time a considerable saving can undoubtedly be shown over the poured-in-place kind. However, some roads prefer to make special slabs to fit the angle of the crossing.

The last item to be considered in connection with the reinforced concrete foundation is the ballast on top of the slab. The main purpose of the ballast is to prevent the concrete from being damaged or shattered by shock, to distribute the load more uniformly over the slab, and to provide a cushion to minimize the jar of the train. Our records show that the practice has been to employ from 6 in. to 24 in. of ballast; my preference is a thickness of 12 in. to 16 in.

Results in Service

We have a record of six steel foundations, tried out by three railroads. One of these roads reported that two installations were made in 1918 and that three years later the steel foundations had to be abandoned because of complete failure. Another road reported three steel foundations placed in 1920, and expressed a preference for timber over steel, but gave no further data on the steel foundations, while the third road installed a steel foundation in 1918 and reported in general that the results have been good, tending to increase the life of the crossing and reduce the cost of maintenance. Thus, of a total of six steel foundations, two were complete failures, three of unknown or at least of doubtful benefit and one seems to have given good results.

Of the pile foundations, our records show a total of 48 installed by three railroads. One road installed three of these foundations in 1923 and reported that the maintenance costs have been reduced and the life of the crossing itself apparently increased. Another railroad reported an installation in 1924, but gave no data on the effect of maintenance or life of crossing beyond the simple statement that it seems to prolong the life of the crossing. The remaining pile foundations of record, 44 in all, were installed by one railroad in 1921; this road reported an increase in the life of the crossings of about 50 per cent and a decrease in maintenance costs of 25 per cent; it adds that the rigidity of the foundations causes hard riding, an effect that is difficult to understand when the resiliency of the timber frame work is considered.

These records speak rather well for the pile foundations, no failures having been reported, and the crossings themselves seem to have been materially benefited, both as to life and maintenance. The pile foundations of which I have just spoken are of the type where one pile is placed under each crossing frog. We have no data on the type where piles are closely driven over the entire area occupied by the crossing.

Concrete Slab Foundations

Of the 20 plain concrete foundations installed on four railroads, one road installed 6, 12 in. thick, in 1924, and reports that very little maintenance is required and that the railroad crossings are in good condition. Another railroad installed one foundation 30 in. thick in 1921 and reports a material increase in the life of the railroad crossing with a reduction in maintenance. This is the same railroad that installed the three pile foundations in 1923 and apparently the pile and concrete foundations are having about the same effect on the crossings.

Another railroad installed one concrete foundation 20 in. thick, but the date of installation is not known to us. This foundation does not seem to have been a success, as the road reported that it was later replaced by one of piles. The remainder of the plain concrete foundations, 12 in number, reported by one railroad, have a thickness of 10 in. and were installed between 1916 and 1926. This road stated that the effect has been to increase the life of the crossing from 60 to 80 per cent and to reduce the maintenance probably 50 per cent.

The foregoing data on plain concrete foundations indicate that good results have been obtained. Out of a total of 20 foundations installed, only one has failed to such an extent as to require replacement.

Of the reinforced concrete foundations, 92 were installed by 8 railroads, 8 of these being installed by one road in 1916. The concrete was precast, had a thickness of 15 in. and was reinforced with ½ in. square rods at 6-in. centers, running in two directions in both the top and bottom of the slab. This railroad reported good results from these foundations, the life of the crossings having been prolonged and the cost of maintenance decreased. Another road reported the installation of 16 reinforced precast concrete foundations 20 in. thick in 1921 with

similar results, stating that the maintenance has been considerably reduced and that an increase of at least 33 per cent in the life of the crossing is expected. The reinforcement consists of ¾ in. square rods at 6 in. centers, arranged in two sets of 3 rods each, running parallel to and directly under the rails in both the top and bottom of the slab.

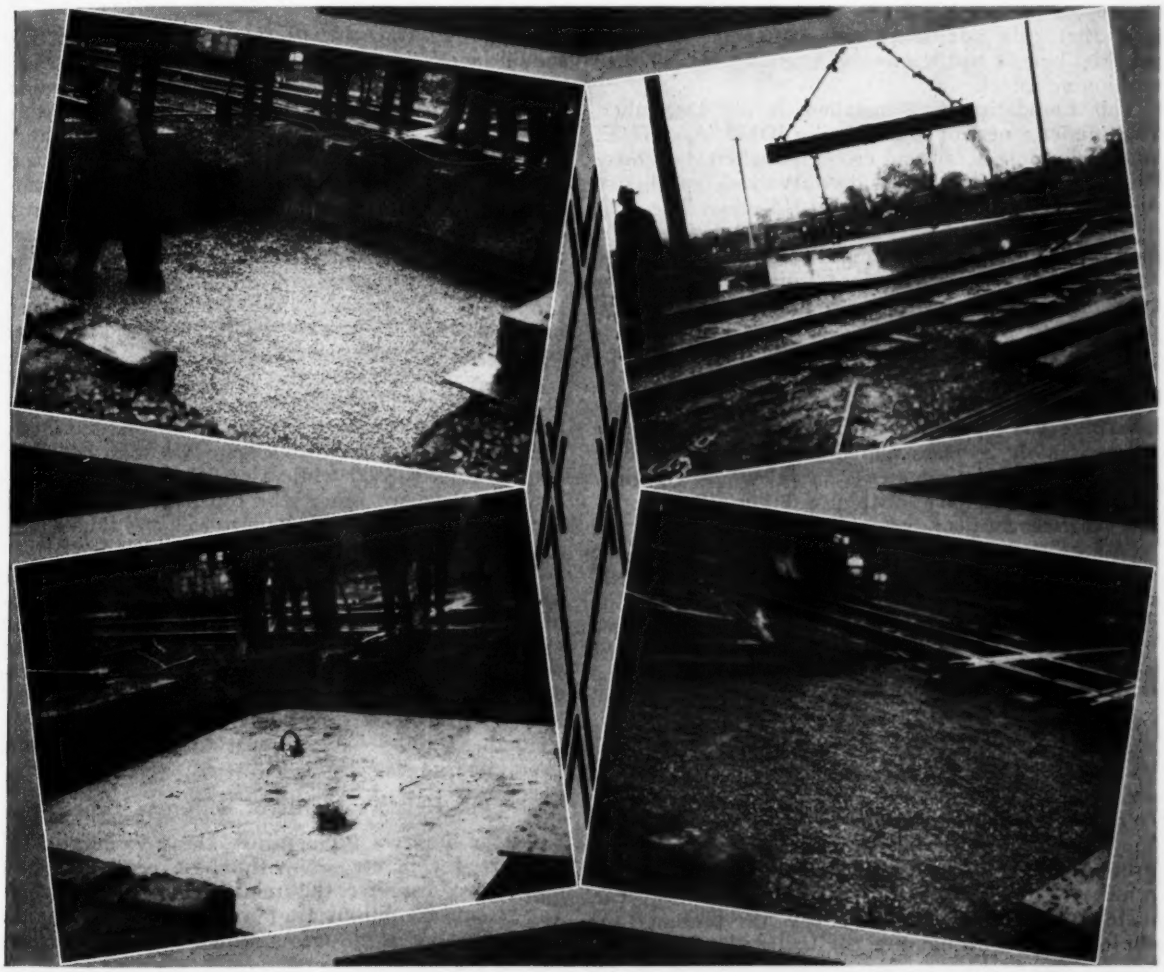
Other Installations of Reinforced Slabs

In 1925 another railroad put in eight reinforced concrete slabs of exactly the same design as the ones just described, but the date of installation is so recent that no definite results have been observed except that little maintenance is required. Another road reported the installation in 1925 of a precast slab 18 in. thick and reinforced with ½ in. square rods at 11¼ in. centers both ways in both the top and bottom of the slab, and stated that maintenance is made easier and that the foundation prolongs the life of the crossing.

Twenty-five reinforced concrete foundations were installed by one railroad between 1920 and 1925 and the results reported show that these foundations have doubled the life of the crossings, prevented the subgrade from working up into the ballast and improved drainage conditions. These foundations consist of precast slabs 16 in. thick, reinforced with ⅝ in. and bottom of the slab. In addition to this main reinforcement ⅝ in. round continuous vertical stirrups were incorporated to resist shearing stresses. Another road reported having installed 30 reinforced concrete foundations in 1923. These consist of a slab 15 in. thick reinforced in both top and bottom with two layers of ¾ in. round rods at 9¼ in. to 10¾ in. centers, running cross-wise of each other. Some of these slabs were precast and others were poured in place. The report showed a decrease in maintenance after the foundation settled and indicated a much longer life for the crossing. No distinction was made in the report between the precast and poured-round rods at 5¾ in. centers both ways, in the top in-place slabs and apparently one is as effective as the other.

From 1918 to 1920 another road installed three concrete foundations 12 in. thick with rods spaced on 18 in. centers with two layers in both the top and bottom of the slab; the size of the rods is not mentioned. These slabs apparently were poured in place and the results have been a material increase in the life of the railroad crossings with reduced maintenance.

I wish to call your particular attention to an installation made by the Terminal Railroad Association of St. Louis. This consists of eight slabs, each



Progressive Steps in the Installation of a Precast Slab

10 ft. by 12 ft. in area, 12 in. thick on one end and 14 in. on the other, reinforced with ¾ in. square rods spaced on 9 in. centers in both directions in both the top and bottom of the slab. The slabs rest on a bed of sand 2 in. thick and have their tops sloped to facilitate drainage to inlets located on the sides of the foundation. In placing these slabs a space of 2 in. was left between them and filled with sand. Four 1 in "U"-bolts were cast in each slab so that it could be handled easily by a derrick from the material yard to the crossing site and then set in place. About 12 in. of rock ballast was placed underneath the ties originally, but some time ago the elevation of these crossings was raised so that we now have about 16 in. of ballast on top of the slabs instead of the original 12 in. Our track supervisor says that this additional ballast seems to be of material benefit to the crossings, as it gives a better cushioning effect.

This foundation was installed during December, 1923, under a nest of four existing 100-lb. A. S. C. E. manganese insert railroad crossings where two busy Terminal main lines cross two Wabash subsidiary main lines at an angle of 55 deg. 14 min. The traffic on the Terminal lines is heavy, consisting of 44 daily passenger trains in each direction and as many or more heavy freight trains drawn by our shifter type of locomotives, having a maximum axle load of about 69,000 lb.

Increased Life Obtained from Crossing

When this foundation was put in, the railroad crossings had been in service since June, 1920, or approximately 3 years and 6 months. They were in such condition that their renewal would certainly have been necessary within another 12 months. The maintenance of grade and alinement of the crossings had become quite burdensome, and the ground or soil would invariably churn and work up, making it necessary to renew the top layer of the rock ballast on an average of about every two months. During wet weather the subsoil became so mushy that the mud and water splashed against a brick building about 12 ft. away, when trains passed over the crossings.

After the foundation was installed and the slabs had reached their final settlement, the ballast became well compacted and now comparatively little labor is required in surfacing and lining or in tightening the bolts of the crossings; the churning of the ground has stopped completely and it is necessary to renew the top ballast only about once every year, instead of every two months. At the present time the only dirt getting into the ballast is that which shakes down from passing trains. Instead of renewing the crossings within 12 months from the time the concrete foundation was installed, they were kept in service until July, 1926, or about 1 year and 7 months longer than would otherwise have been possible.

The Economic Consideration

Let us now consider these reinforced concrete foundations from an economic standpoint. Are they a good investment in dollars and cents? In the final analysis, that is about the only consideration that counts. We have insufficient data from other railroads as to their experience along these lines, but I will give you our record with respect to the crossings just described. The cost of the eight reinforced concrete slabs, including the transportation to the site, with the labor of setting to one side the old railroad crossings, excavating for the slabs, installing the slabs, placing the ballast and reinstalling the old crossings, amounted to about $1750.

The four crossings cost $5284. At the time the foundations were installed they had been in service about 3 years and 6 months and there remained 12 months or less service in them; so without the aid of the foundation we would have obtained a life of approximatetly 4 years and 6 months. On this basis these crossings cost $1174 annually.

Savings Effected

After installing the reinforced concrete slabs, their life was prolonged to 6 yr. and 1 mo. and the annual cost becomes $869, representing an annual saving of $305 directly traceable to the foundation. To this should be added the saving in the labor of removing and of reinstalling the crossings, this operation amounting to about $320. If we have to do this work every 4 years and 6 months, the annual charge is about $71; if it has to be done every 6 years and 1 month, the annual charge becomes $53, representing an annual saving of $18. The combined saving, due entirely to the prolonged life of the old crossings, therefore, amounts to $323 per annum. The life would have been considerably longer than 6 years and 1 month, if the foundation had been installed when the crossings were new and a greater annual saving could have been shown.

Let us now consider the saving due to decreased maintenance. The estimated cost of renewing the top ballast for the four crossings is $50. Formerly we incurred this expense every two months at an annual cost of $300 while since the foundation has been in place we renew the top ballast about once every year, reducing this item to $50, and thus effecting an annual saving of $250.

This added to the $323 previously mentioned, makes a total saving each year of $573, brought about through an expenditure of $1750, showing that these slabs will pay for themselves in about three years. I have not included any figures representing the saving in the item of tightening bolts and other incidentals, so that I feel justified in saying that these slabs have proved to be a very good investment.

The Relative Merits of Different Types

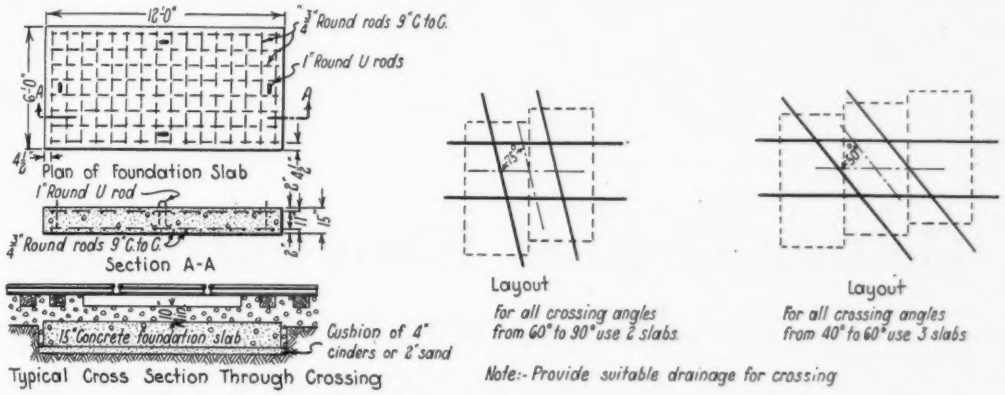
Of the different types in use, the wooden pile and reinforced concrete show the best results, and of these two I prefer the reinforced concrete where the ground conditions are normal; that is, where the bearing value of the ground and the moisture content are about the average. There are several reasons for this preference. The life of the reinforced concrete type is longer than of the wooden pile type and the item of foundation maintenance is in favor of the reinforced concrete type. Another advantage of the reinforced concrete type is the ease and simplicity of installation, which is a matter of vital importance where the traffic is dense and the crossing can be taken out of service for only a short period at a time. The slabs can be poured in a material yard and hauled to the site, or cast alongside the crossing site and all the necessary preparations made for their installation. When the track is taken out of service the excavation can be made quickly and the slabs lifted and dropped into place.

In the case of piles the track must be kept out of service during the entire driving operation and

while the pile heads are being cut off, which operations consume a considerable length of time. The reinforced concrete type is probably the cheaper of the two, principally because it can be built with labor that takes a lower rate of pay.

The A. R. E. A. Plan

Our A. R. E. A. committee developed a plan, a copy of which is shown, as a suggested standard for reinforced concrete foundations for railroad crossings. The thickness of the slab is 15 in. and the reinforcement consists of ¾ in. round rods spaced on 9 in. centers in two directions in both the top and bottom of the slab. A cushion of 4 in. of cinders or 2 in. of sand under the slab and a minimum of 10 in. of ballast underneath the ties are shown. The shape of each slab is a rectangle 6 ft. by 12 ft.; this size will adapt itself to any angle of crossing above


12'-0"
¾" Round rods 9" C. to C.
1" Round U rods
6'-0"
Plan of Foundation Slab
1" Round U rod
¾" Round rods 9" C. to C.
Section A-A
15" Concrete foundation slab
Cushion of 4" cinders or 2" sand
Typical Cross Section Through Crossing
Layout
For all crossing angles from 60° to 90° use 2 slabs
Layout
For all crossing angles from 40° to 60° use 3 slabs
Note:- Provide suitable drainage for crossing

A. R. E. A. Suggested Design for Concrete Crossing Slabs

40 deg. For crossing angles from 40 deg. to 60 deg. three slabs are required and from 60 deg. to 90 deg. two slabs.

The drawing carries the note "provide suitable drainage." The committee did not attempt to indicate the type of drainage to be employed because each crossing constitutes a special problem in this respect and the difference in the topography of the ground, the nature of the soil, the proximity of sewers, the amount of rainfall and other conditions preclude the possibility of standardization.

The plan evolved by our committee is not expected to be a panacea for all crossing troubles, but rather a suggested design suitable for most crossings under average conditions. It shows a foundation, the installation of which will produce results that will more than justify the expense involved.

Discussion

The interest with which the paper was received was reflected in the active discussion which followed its presentation. A. E. Muschott (E. J. & E.) described eight crossings with reinforced concrete foundations which had been installed during the last eight or nine years and said that they had proved satisfactory in every case, reducing the cost of maintenance and lengthening the life of the crossing. The slabs were precast in one piece for each crossing, their shape being designed to fit the angle of intersection. The slabs are 20 in. thick and are placed to allow 8 in. of slag ballast, ranging from ¾ in. to 1¾ in. in size, under the ties. The ballast is renewed entirely about every three years, since it disintegrates sufficiently in that time to make new ballast desirable. Mr. Muschott expressed a preference for only four inches of ballast, believing that amount sufficient to provide a cushioning effect and requiring less labor for renewal. In placing the slabs the excavation is made large enough to provide a space of about 12 in. around each edge of the slab, which space is filled with coarse ballast to facilitate drainage from the slab. Tile drains lead away from the edges of the slab, their location being contingent on local conditions. The tiles sometimes break from the pressure exerted by traffic and to obviate this Mr. Muschott believed that perforated corrugated pipe might be used to good advantage. Only one of the slabs has settled to any extent, one corner being three inches low, due probably to a soft spot in the ground. The settlement was slow and the crossing was maintained with some extra work but with little trouble until the settlement ceased, since which time little maintenance has been required. Mr. Muschott stated that in installing the crossings, it was his practice to bolt two track ties together and place them longitudinally under the rails of the crossing on the heavy traffic line to provide continuous support. These ties are replaced when the ballast on the slabs is renewed, and on heavy traffic lines are usually worn down to a thickness of about 4 in. by the ballast.

In reply to a question by J. J. Desmond (I. C.) if there was any unevenness of bearing at the point where the approach rails reach the ballast on the slab, similar to that sometimes encountered at the end of ballast deck bridges, Mr. Harting replied that none had been observed and F. W. Hillman (C. & N. W.), stated that he would expect none since the conditions at these slabs differed materially from those obtaining on ballast deck bridges. In this connection Mr. Muschott thought that special rails should be furnished where the crossing rails are of different section than those used in the track, so that the step joints would come back of the ends of the wing rails of the crossing.

G. J. Slibeck (Pettibone, Mulliken & Co.) attributed much of the trouble with crossings to foundations or drainage, or to a combination of the two. Owing to the increased stresses due to the crossing he believed that crossings should be of heavier section than the rails of the track in which they were used. In the case of solid manganese crossings, he urged that, due to the fact that manganese steel has less girder strength than ordinary rail, the height

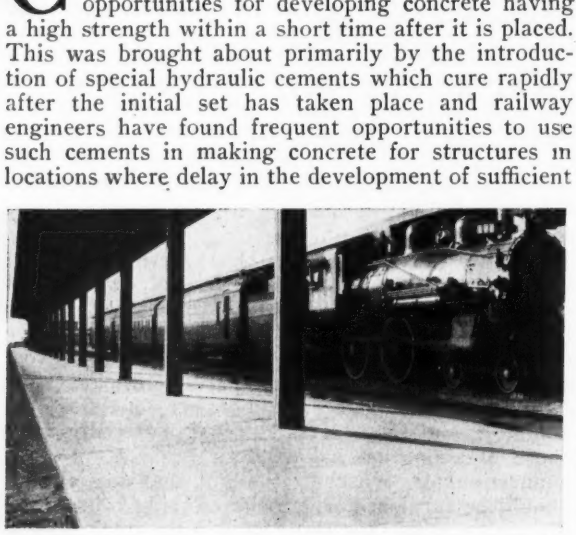
of the rail should never be less than 6½ in., or the height of the 120-lb. R. E. section of rail, and a piece of rail the same height as the rail in the crossing should be connected to each wing rail, thus removing the step joint from the ends of the crossing.

T. Thompson (A. T. & S. F.) suggested the use of a clam shell in excavating for the installation of the slabs and Mr. Muschott stated that in one instance where slabs were to be placed at a crossing of his line with an important double track line, two cranes were used, one with a clam shell for excavating the pit and the other to place the slabs. Here time was an important element and justified the use of the extra equipment. In reply to the suggestion of Mr. Thompson for the use of a bed of cobble stones from 12 in. to 16 in. deep under the slabs, Mr. Harting replied that in ordinary soils this would not be required. Mr. Thompson's suggestion that quick-hardening cement might permit the slab to be cast in place elicited a general discussion in which W. S. Lacher *(Railway Engineering and Maintenance)* stated that while the use of such cement would allow the slab to be placed in service in 24 hours the justification for its use would depend on how long the track could be kept out of service and that the element of cost must also be considered since the cost of such cement is greater than that of ordinary Portland cement. To a question from Mr. Hillman as to the use of the water-cement ratio, he replied that while this would shorten the period required for the concrete to attain a certain strength the element of time must still be considered. Mr. Hillman cited a case on his road where the element of cost ruled against the use of a quick-hardening cement while R. L. Cochrane (A. T. & S. F.) stated that on some grade elimination work where time was of importance, the use of such cement permitted trains to be run over concrete construction within 22 hours after it had been put in.

C. T. Kimbrough (I. H. B.) asked if a thickness of 8 in. would not be sufficient for the slab, since its principal function seemed to be to prevent the material of the subgrade from working up onto the ballast. Mr. Harting replied that the thickness was determined by the necessary strength of the slab and that the saving in first cost effected by reducing the thickness of the slab would not be great enough to justify taking the risk of failure.

Getting Greater Early Strength In Concrete

CONSIDERABLE interest has been shown during the last two or three years in the opportunities for developing concrete having a high strength within a short time after it is placed. This was brought about primarily by the introduction of special hydraulic cements which cure rapidly after the initial set has taken place and railway engineers have found frequent opportunities to use such cements in making concrete for structures in locations where delay in the development of sufficient strength to carry load introduces serious complications in working out the construction plan.



Early Strength Concrete Is of Marked Advantage in Station Platforms

That somewhat comparable results can be obtained with standard Portland cements has been shown in a recent bulletin of the Portland Cement Association which points out that the use of a smaller quantity of water per sack of cement not only results in a greater strength at all ages but that this increase is particularly marked at early ages, that is, from one to three days. It also calls attention to the fact that with some Portland cements, the admixture of calcium chloride will add to the early strength. In brief, the plan provides for the use of a greater proportion of cement than is used in ordinary mixes, but even with this greater outlay for cement the total cost may in many cases be less than if a smaller quantity of special high-early-strength cements were used. The following is an abstract from the bulletin:

Factors Which Govern Strength

The more important factors governing the strength of concrete are the quantity of cement, the quantity of mixing water, the temperature of the ingredients, the time of mixing, the temperature and moisture conditions during hardening and the age. Tests show that the first two are the most important. Other conditions remaining the same, the strength of concrete is shown to be fixed by the ratio of the quantity of mixing water to the quantity of cement, provided only that the mixes are plastic and workable and the aggregates clean and structurally sound. The accompanying table and explanation show the influence of these factors, as determined by laboratory tests for average materials. A similar range in strength for different water-cement ratios will be found for most materials. Where tests or actual construction experience for specific materials are lacking, tests should be made.

The table shows clearly the increase in strength that results from reducing the quantity of mixing water, also the corresponding increase in the richness of the mix to maintain the same consistency. For the same water-cement ratio, for example, in the third and fourth items in the table, with six gallons

of water per sack of cement, the strengths are seen to be the same for the two mixes indicated, 1:2:3½ and 1:1½:3. The leaner mix, of course, is the stiffer, as indicated by the lesser slump. The comparison of cement quantities for these two mixes shows that 0.25 bbl. (1 sack) per cu. yd. additional cement is required to maintain the same water-cement ratio when the fluidity is increased from a ½-in. slump to a 6 or 7-in. slump.

Temperature at Placing and During Curing

Next in importance to the water-cement ratio is temperature at placing and during curing. The gain in strength is greatly retarded by temperatures below 60 deg. F. For high early strength requirements it is important that a temperature of 70 deg. be maintained during the early curing period. In cold weather work it is necessary that the materials be heated so that the concrete will have a temperature of not less than 70 deg. when it is placed. The concrete should always be kept from drying out during the first week or 10 days.

Increasing the mixing time to two minutes will add about 100 lb. per sq. in. to the strength of all mixes at three days, and five minutes mixing will add about 200 lb. per sq. in. The additions to the one-day strength will be about half of these amounts.

How the Water-Cement Ratio Affects Early Strength

Based on 70 deg. F. minimum temperature of concrete when placed and during curing and a minimum time of mixing of one minute.

Water-Cement Ratio (Gal. per sack)	Compressive Strength (cured wet until test) 1 day	3 days	7 days	28 days	Typical Mixes (Illustrating range for a particular set of aggregates) Slump (In inches)	Mix	Cement (Bbl. per cu. yd.)
7½	100	500	1100	2000	6-7	1:2:3½	1.40
6½	230	830	1530	2600	2-4	1:2:3½	1.40
6	300	1000	1800	3000	½	1:2:3½	1.40
6	300	1000	1800	3000	6-7	1:1½:3	1.65
5½	370	1230	2070	3400	2-4	1:1½:3	1.65
5	470	1500	2400	3900	½	1:1½:3	1.65
5	470	1500	2400	3900	6-7	1:1:2	2.25
4½	600	1800	2800	4300	2-4	1:1:2	2.25
4	830	2130	3170	4900	½	1:1:2	2.25

Free water or moisture carried by the aggregates must be included in computing the water-cement ratio. Any water absorbed by the aggregate from the dry condition while mixing and placing may be deducted.

The slumps, mixes and cement quantities shown in the last three columns are given for illustration only. They are accurate for a particular set of aggregates, sand and pebbles from Elgin, Ill., artificially graded 0 to 4 and 4 to 1½, and are based on dry compact measurement of aggregates. These slumps and cement quantities would not hold for the given mixes using other aggregates or gradings, *but the strengths* indicated should hold for the given *water-cement ratios* for any clean, sound aggregates, provided the mixtures are plastic and workable.

Use of Calcium Chloride as an Accelerator

With some cements the use of two pounds of flake calcium chloride with each sack will add further to the early strength. Such additional strength should not be counted upon unless it is proved by tests that the given cement will react in this manner.

Where calcium chloride has given increased strength it has been found greater for the richer and stiffer mixes than for the leaner or more fluid ones. For mixes with water-cement ratios higher than 6 gal. the increase is negligible, but for water-cement ratios of 4½ or 5 gal. the increase with some cements has been as high as 800 lb. per sq. in. The increase (in pounds per square inch, not percentage) from calcium chloride for any given mix is nearly the same for all ages.

Wage Increases For Maintenance Forces

AN INCREASE in pay was granted to maintenance of way foremen on the Union Pacific system, effective March 1. Under the agreement heretofore in effect with the Maintenance of Way Foremen's Association-Union Pacific System, section foremen were paid a minimum or basic rate of $112 a month on branch lines and $115 a month on main lines, with an additional allowance ranging from $2 to $10 a month in terminals, yards and mountain and desert territories. A further allowance of $2 a month to branch line foremen and of $2.50 a month to main line foremen was provided for each 12 months of continuous service until such increase reached a maximum of $16 on branch line and $20 a month on main line sections. Under the new agreement, which was concluded on February 21, the basic rates of $112 and $115 a month were increased to $117 and $120 a month, respectively. The number of men affected is approximately 1,400.

In addition to section foremen certain other classes of foremen received advances in pay. Assistant section foremen were granted an increase of $5 a month, bringing their rate to $110 a month; extra gang foremen supervising less than 60 men on other than main track rail relaying work also received an increase of $5 a month, establishing a rate of $155 a month; foremen of maintenance of way repair shops, of whom there are 10 on the system, received an increase of $15 a month, establishing a rate of $215 a month; and the rate for sand oiling foremen, of which there is only one on the system, was increased to $170, an advance of $10 a month. A few minor changes were also made in the rules to clarify their application. The new agreement is effective for one year, subject to 30 days' notice of change thereafter.

The maintenance of way employees of the Chicago & North Western, numbering about 15,000 who belong to the maintenance of way brotherhood, have asked for an increase in pay of five cents an hour which the company has refused to grant, asserting that this would entail an increase of $2,500,000 annually to its payrolls. Through the efforts of E. P. Morrow and F. E. Bickers, representatives of the United States board of mediation, the parties to the dispute have signed an agreement to submit the matter to arbitration. Representatives of the board of mediation are also considering a dispute between the Chicago, Indianapolis & Louisville and its maintenance of way employees.

Tallassahatchie Creek Bridge on the Mobile Division of the Southern

What's the Answer?

What Our Readers Have to Say on Current Questions That Perplex Those Engaged in Maintaining Tracks, Structures and Water Supply Facilities

QUESTIONS TO BE ANSWERED IN THE JUNE ISSUE

1. *In surfacing track out of face how close to the jacks should the work be carried before the jacks are moved ahead?*
2. *Is it good practice to use second-hand timber for bulkheads at the bank bents of timber trestles?*
3. *What is the shortest length of guard rail that can be used satisfactorily for high speed main track turnouts with No. 11 or sharper frogs?*
4. *What practical changes can be made in the treatment of water where the lime-soda process is used which will prevent incrustation of the pipe line without increasing boiler corrosion?*
5. *To what extent is it advisable to level up the right of way so that mowing may be done by machines instead of by scythes and to improve the appearance?*
6. *What is the best method of protecting the concrete in dry cinder pits from injury by the heat?*
7. *How can the churning of ballast on ballast deck bridges be prevented?*
8. *What is the best type of floor for section tool houses?*

Track Liners for Main Line Sections

What are the relative merits of track liners and lining bars for main line sections?

Track Liners Do Better Work at Less Cost

By J. J. Desmond
Roadmaster, Illinois Central, Chicago

Throughout the years of railroad maintenance lining bars have been used to line track on main line section work. With the increase in the weight of the track structure a greater number of men per section are necessary in order to place tracks in proper line by the use of ordinary lining bars. Continual strain is placed upon the men when performing this class of work and satisfactory lining cannot be done where track is heavily ballasted and well filled in to the top of ties. Therefore, the number of men usually required for this work ranges from 7 to 15 and they are required to work under extreme exertion. It is possible that line kinks can be taken out temporarily by the use of a few less men but satisfactory results cannot be obtained. The final result where appropriations are meager is that the laborers must be transferred from one section to another in order to build up a sufficient number of men to handle the track structure with lining bars.

The average main track becomes line-kinked at various times. The heavy power, swaying from one side to the other, tends to increase this condition which no doubt was originally set up on account of the track never having been placed in true alinement. Straight track, when maintained in proper surface and lined properly, seldom develops line kinks, although there may be long swings in the alinement which will not cause irregular riding. By the use of lining bars considerable unnecessary expense is involved, as moving the track by this method naturally requires man power and without plenty of man power, lining bars cannot be used to good advantage. In addition, the men often receive permanent ruptures or other personal injuries, due to the heavy strains.

During recent years track liners have been developed which permit heavy tracks to be lined with a smaller number of men. Tracks that require heavy lining can be handled with from three to five men without difficulty. The additional purchase gained by the use of these track liners over the lining bars is very perceptible and lining work can be carried on satisfactorily without transferring men from one section to another in times of force reduction while the hazard of personal injuries is reduced considerably.

Placing the liner in its proper position enables the track structure to be moved to correct alinement with little exertion on the part of the men. It is found that much less work is necessary when lining track, if the entire territory, where the track is to be lined, is stirred slightly. This will reduce the possibility of unevenness in line and avoid a quick return of a line kink, where track is only slightly out of surface. The use of track liners often tends to remove the slight irregularities and leave them in such condition that when the first trains pass over they iron it out to almost a true condition. There is no doubt that the use of track liners considerably increase the efficiency of the laborer and the length of track lined per day. The track liner also shows

a remarkable saving over the old system and produces smoother riding track. Comparative tests have shown that there has been a saving of 50 to 60 per cent in labor costs and in many instances a great reduction in the expense of tools.

Should Heart Maple for Exterior Platforms Be Treated?

Is it advisable to treat heart maple lumber for installation in exterior freight house platforms? Is other timber better adapted for this service?

It Should Be Treated

By George M. Hunt
In Charge Section of Wood Preservation, Forest Products Laboratory, Madison, Wis.

Maple is an excellent wood for platforms that must stand considerable wear. There are other good woods also but probably none excel maple appreciably. The wood is not very resistant to decay, however, and it cannot be expected to last many years exposed to the weather unless protected by preservative treatment. Its resistance to mechanical wear is better than its resistance to decay and we should say, therefore, that as a general policy it would be very desirable to treat heart maple lumber to be used for exterior platforms.

Untreated Heart Maple Decays Rapidly in Exterior Platforms

By Engineer of Buildings

Untreated heart maple has been used for exterior platforms, particularly where it was subjected to heavy trucking, since it is a dense wood and does not wear out rapidly. The same characteristics have also led to its use as lining for ore docks. It is not resistant to decay when exposed to the weather and also has a tendency to warp when used on exterior work; hence it is economy to treat such lumber unless it is to be used for interior floors and platforms, where the untreated material has a long service life.

Depth of Ballast on Ballast Deck Bridges

What is the minimum depth of ballast on which track can be maintained satisfactorily on ballast deck bridges?

Six Inches of Ballast Will Afford Drainage and Distribute the Weight

By L. H. Bond
Engineer Maintenance of Way, Illinois Central, Chicago

The ballast on bridges is an entirely different matter from the ballast on the roadbed, where a depth up to 24 in. on heavy traffic lines distributes the load over the subgrade and decreases the cost of maintenance. In this case the weight of the ballast has no particular effect on the roadbed and is of material advantage. On the other hand the least depth of ballast than can be used satisfactorily on ballast deck bridges the better. The floor of the bridge distributes the load over the stringers and any increase in depth over six inches serves no particular purpose as ballast, as this depth will afford drainage with the minimum weight. Stone is particularly suited for ballast deck bridges as it protects the metal portions, such as bolts, drift bolts and nails from corrosion better than other kinds of ballast.

Not Less Than Eight Inches Should Be Used

By L. V. Lienhard
Roadmaster, Atchison, Topeka & Santa Fe, Pueblo, Colo.

Track can be maintained satisfactorily with a minimum of three or four inches of ballast under the ties, provided the ballast material does not contain fragments too large to permit of proper tamping. However, as far as the bridge is concerned this may not be true as with such a small amount of ballast under the ties the life of the bridge will probably be shortened. Therefore, when constructing a ballasted deck bridge, provision should be made for not less than eight inches of ballast under the ties as such a depth will better preserve the continuity of roadbed conditions and the shock to the structure will be considerably less from moving loads than is the case when only three or four inches of ballast is used under the ties. Gravel ballast, composed principally of round pieces, should not be used on a bridge as it is difficult to maintain good line and surface with such material.

The Effect of Pumps on the Maintenance of Pipe Lines

To what extent is the maintenance of pipe lines affected by different types of pumps, and also by the condition of the pump?

Reciprocating Pumps Sometimes Cause Damage to the Joints

By J. D. Keiley
Supervisor, Chesapeake & Ohio, Russell, Ky.

Pumps of the reciprocating or plunger type affect the maintenance of pipe lines to a much greater extent than do those of the rotary or centrifugal types. The reciprocating pump forces the water through the pipe by a series of strokes which cause pulsations in the line at the beginning and end of each stroke. These pulsations are always present but are not usually great enough to cause any trouble if the pump is in good condition. However, if the valves are worn or do not seal properly the pulsations are greatly intensified and often cause leaks at the joints. On the other hand rotary or centrifugal pumps cause an even and continuous flow of water through the line and avoid the extra pressures due to pulsations.

The Condition of the Pump Is of Greater Importance Than the Type

By E. M. Grime
Engineer Water Service, Northern Pacific, St. Paul, Minn.

It should be fair to assume in the beginning that the pipe line is properly designed to withstand the maximum pressure that may be required and that the pump is likewise properly proportioned for the work required. As far as the type of pump is concerned, this will make no appreciable difference in the maintenance of the pipe line except that if for some particular reason the pressure on the line is run up considerably beyond its capacity, a simple plunger or pulsating type of pump may, by reason of the fluctuation in pressure, blow out a weak joint

or damage a weak length of pipe near the pumping station sooner than will the more even flow from a triplex or centrifugal type of pump. Where a triplex pump is used, if one of the pistons should be "missing," the pulsations will be so irregular that this may cause a greater strain on the pipe than usual and thus affect the maintenance.

Tuberculation or other types of incrustation in a pipe line will have more influence on its maintenance than the type of pump. Naturally in an effort to keep up the supply the pump may be speeded up or other means taken, the result of which will be to increase the pressure so as to get the required supply through a line of decreased diameter. If the pipe line remains clean and therefore of full capacity, the type of pump should have little effect on its maintenance.

Flags or Metal Plates for Temporary Slow Signs?

What are the relative advantages and disadvantages of flags and metal plates for temporary slow signs?

Metal Plates Are Preferred

By J. D. Keiley
Supervisor, Chesapeake & Ohio, Russell, Ky.

Metal plates are preferable to flags for temporary slow order signs because they are more easily seen from the engine cab. A metal plate will keep its position to afford the proper indication whereas a flag will be blown about by the wind and will often wrap around the staff, especially during a rain. Metal plates will last longer than flags and there is less chance of their being tampered with by trespassers.

Metal Plates Have Many Advantages

By Supervisor

Metal plates have many advantages over flags as temporary slow signs, since they can usually be placed to give a clearer indication than can flags and, as a rule, the lantern for night indications can be fastened to them more securely than it can to the staff for the flag. Where metal plates are used they should be of standard design for any one road so that there may be no mistaking their meaning by the enginemen. Serious objections to the use of flags are their tendency to become folded during storms, unless a staff is used for both ends of the flag, and the dimming of the color during rains.

Protecting the Tops of Cut Off Creosoted Piles

What is the best method of protecting the tops of creosoted piles after cutting them off?

An Effective Method

By A. F. Robinson
Bridge Engineer, Atchison, Topeka & Santa Fe System, Chicago

After the piles in a bent are cut off for capping we treat the freshly cut ends with two or three applications of hot creosote. We mix with this creosote some heavy road oil or special asphalt preparation, which is thick and gummy. On top of this coating we place a layer of prepared roofing paper and the top of this roofing paper is thoroughly coated with the creosote and heavy oil, after which the cap is applied. We have used this method now for some years and it is very satisfactory.

Some years ago we made up a series of steel bonnets or pile caps to which we applied the hot creosote under pressure. This, however, proved to be expensive and we did not succeed in getting the end penetration that was thought necessary. For this reason we have not followed up the scheme further than the experimental stage.

Protect All Exposed Surfaces

By G. A. Haggander
Bridge Engineer, Chicago, Burlington & Quincy, Chicago

The method used on the Burlington, and which I think is the best method, is to paint the tops of the piling with hot creosote after cutting them off. On top of this is laid a layer of heavy roofing paper, and the cap is then placed on this roofing paper. When the drift bolt hole is bored through the cap into the pile, this is poured full of creosote before the drift bolt is driven. It is thought that the roofing paper will press close to the top of the pile and shed water, effectively sealing the pores in the wood, and that the brush treatment of creosote will be effective for an indefinite period.

The Supervisor's Clerk

What are the qualifications of a supervisor's clerk and what should be his duties?

He Must Have a Knowledge of the Work and Attend to Many Details

By J. P. Corcoran
Roadmaster, Chicago & Alton, Blomington, Ill.

Considering the first part of the question and comparing the reports that must be made at the present time with those required some years back it will be seen that the supervisor's clerk must have at least a good common school education in order that he may interpret readily and understand the various rulings and instructions concerning his monthly reports, nearly all of which are used in connection with valuation and accounting and with reports required by the Interstate Commerce Commission. He should also be able to go out on his supervisor's district and instruct the foremen as to making their reports properly, doing this in a way that will make the individual foreman feel that he is being helped instead of criticized.

The clerk should be able to handle all routine correspondence, thus relieving the supervisor of this work which otherwise might require its being done late at night or on Sunday. The clerk should also handle the distribution of ties and ballast, arranging with the chief dispatcher as to the time and place of unloading, and with the track gangs so that they will be on hand to prevent delays to the trains handling the materials. In doing this he should keep careful watch of foreign cars to reduce per diem charges to the minimum. He should also be familiar with the contracts and rules regarding industrial tracks so that he may handle questions promptly regarding them in the absence of the supervisor or, if there is any point that is not clear, he may have full information to present to the supervisor.

As to the clerk's duties, he should handle everything that comes into the office, calling the super-

visor's attention promptly to all important matters. His regular duties should be as shown in the following list:

1. He should keep a correct record of all material received, used, and transferred from one section or district to another, thus insuring that no delays will result from shortage and that no waste will be occasioned by having a surplus. Such a record is also of great value at the time of accidents or other emergencies when material must be loaded in a hurry.
2. He should check the time books each period, seeing that extensions are correct and that all overtime is properly listed so that the supervisor may be able to explain it if called on to do so.
3. He should see that the information for the various reports which the roadmaster must furnish to other departments is available promptly and correctly for consolidation by the roadmaster.
4. Since most supervisor's headquarters are located at division terminals, the clerk should follow up all cars of roadway material so that they can be unloaded promptly.
5. Records should be kept showing the amount of work done and the cost per unit. Records should also be kept up to date of the kind of rail and ballast in track.
6. Where maintenance of way matters are handled by a division engineer or roadmaster the supervisor's clerk should come directly under the chief clerk of the officer in charge. He should watch the reports to see that all charges to A.F.E. work are properly made and transmitted so that the costs may be compiled when the work is completed.
7. When work trains are used to a considerable extent the clerk or a timekeeper should accompany the train, if possible, to see that the materials are properly unloaded to eliminate extra work by the track gangs and to expedite the work. This will also enable him to get the cost of unloading the material.
8. The clerk should keep his filing system so that all correspondence relating to any particular subject is readily available.
9. The clerk should be familiar with track plans so that he can see that the necessary materials are provided for the work. He should also see that all changes are entered in the office records as soon as they have been completed.

He Should Have Qualities That Fit Him for Promotion

By Operating Officer

In the bridge and building department on most railways the supervisors' duties cover the maintenance of buildings, bridges, and water supply, in fact practically everything in the maintenance of way not included under roadway and track. The position of supervisor's clerk therefore offers a wide range of duties and the person having this place should be absolutely reliable in all kinds of clerical work and be of such a practical turn of mind as to be able to grasp most of the details and clearly understand the various items of work in progress. Thorugh the correspondence files he should keep in close touch with what each of the work crews is doing and know that they are provided in advance with the necessary material so that there may be no delay to their work. He should also be familiar with the line-up for future work, and keep the necessary check on requisitions for additional material. Numerous details of office work involving pay checks, time slips, passes, seniority roster, etc., are always requiring careful attention and he has many opportunities to relieve his chief of routine affairs and thereby make himself practically indispensable. One of his most important duties is to keep a daily check on expenditures for both the "additions and betterments," and "repairs" accounts so that on any day he can say just how the department stands with the monthly allowance.

The supervisor is necessarily out on the line a good share of the time, and the efficient clerk has the opportunity to be his most important assistant. This position perhaps more than any other in the clerical line gives opportunity for a broad education in railway maintenance matters, and those who make the most of the opportunities that it presents are usually rewarded by promotion or else are placed in a position to became successful in other lines of construction work.

He Should Have a General Knowledge of the Work

By J. D. Keiley
Supervisor, Chesapeake & Ohio, Russell, Ky.

The qualifications of a supervisor's clerk are dependent on the duties of the supervisor. He should be able to take short-hand, use a typewriter and have at least the equivalent of a high school education. He should be in line for promotion into either the division engineer's office, the roadmaster's office, or the superintendent's office, and in this way there will be an incentive for the right kind of man to take the job.

Under any consideration he should be thoroughly familiar with the various kinds of material used by the supervisor's force—whether it be track, bridges and buildings, water supply or signal. He should have a general knowledge of the character of the work going on, and this is important even to the point, if necessary, of sending him out on the job to see what is going on.

He should check time sheets, keep the seniority roster, check material reports and handle any errors in the pay to the men. The last item is very important, as when a man thinks he is not getting full pay for his work and the mistake is not rectified at once, there will be a great deal of dissatisfaction. More dissatisfaction can be caused by a short answer or by paying no attention to a man when he thinks his pay is short than any other way.

Experience and Good Judgment Are Essential

By F. W. Easton
Roadmaster, Southern Pacific, Ogden, Utah

A clerk for a roadmaster or supervisor of track should have had experience as a timekeeper on road way gangs and also enough office experience to familiarize him with the accounting rules of the maintenance of way department. He should be familiar with the maintenance of way standards and should have a working knowledge of track material as well as a fairly good knowledge of bridge and building and signal materials. He should know the rules and regulations of the maintenance of way department and should be familiar with the operating rules insofar as they govern the operations of work trains or are connected in any way with the maintenance of way department.

To acquire this knowledge he should have been long enough in the maintenance service so that he will have the experience and confidence to act

promptly and efficiently in emergency matters in the absence of his superior and above all he should have the common sense and judgment to handle men. The selection of a man for this position should be made by examination in which ability and seniority are both given weight.

His duties should be confined to the clerical and routine work of the district, and he should be able to operate a typewriter for such accounting work as his position demands but he should not be called upon to do other work which belongs properly to the accounting department. He should have time to check over all time rolls and distribution sheets carefully, especially as to overtime so that all information will be complete when the rolls are presented for signature.

Material reports demand accuracy and to secure this a knowledge of materials is necessary since a check must often be made on the ground. To facilitate this and to avoid excessive adjustments when the annual inventory is taken he should have jurisdiction over timekeepers who report material as well as material clerks who are employed on special jobs.

The roadmaster's or supervisor's clerk should be on the same footing as the trainmaster's clerk and his assignment should be sufficiently elastic so that he can see his superior outside of regular office hours when necessary. The position requires a man of good judgment and should not be made a stepping stone to other clerical positions.

Keeping Walls of Shops and Enginehouses White

Where the interior walls of shops and enginehouses are painted white to increase the distribution of light, what is the best method of keeping them white?

Whitewash Enginehouse Walls and Repaint in Shops

By A. R. Raymer
Assistant Vice-President and Chief Engineer, Pittsburgh & Lake Erie, Pittsburgh, Pa.

It has been our experience that in enginehouses painted walls cannot be kept white, and that whitewash or similar products are the only thing that can be used successfully. In machine shops and erecting shops, where engines are not fired up, white paint can be used. We have not felt that it was practical to wash the walls in shops and consider that it is necessary to repaint when the white paint becomes discolored.

Repaint Enginehouse Walls with Inexpensive Paint and Wash Shop Walls

By A. N. Reece
Chief Engineer, Kansas City Southern, Kansas City, Mo.

Where the interior walls of shops and enginehouses are painted white to increase the distribution of light, it has been my experience that it is less expensive to repaint enginehouses rather than to employ some method of cleaning the walls and ceiling, especially where some form of cold water or inexpensive paint is used. In the case of back-shops, it is my belief they can best be painted with a better grade of paint, that is, one susceptible to cleaning and with an occasional cleaning a satisfactory appearance can be maintained for as long as four years and possibly longer.

Smoke in Enginehouses Should Be Reduced to a Minimum

By J. D. Keiley
Supervisor, Chesapeake & Ohio, Russell, Ky.

Roundhouse lighting has generally been very badly neglected and has not received the careful study that its importance warrants. The most progressive modern industries have been quick to realize the importance of proper and adequate shop lighting. They have spent large sums of money to furnish sufficient light and have increased the quality and quantity of work as a result.

Money spent in keeping smoke from the engine stack out of the roundhouse is a wise investment. Not only does it increase the efficiency of the lighting system, but it makes a more healthful place in which to work, as smoke-laden air is injurious both to the eyes and lungs.

Where the walls have been painted white to increase the distribution of light before the engines are put into the roundhouse a cap should be placed over the smoke stack until the engine is moved directly under the smoke hood. The smoke jack should then be lowered over the locomotive stack after the cap has been removed. If properly designed smoke jacks are used and the supervision is sufficient there is little or no excuse for any smoke within the roundhouse.

Protection of Water Mains—A Further Answer to an Earlier Question

What special precautions should be taken where water mains are laid under tracks carrying heavy traffic?

Bridging Is Sometimes Necessary

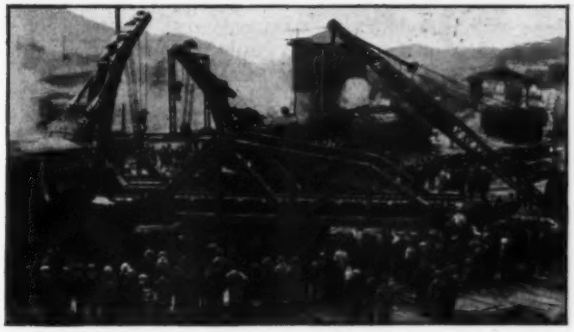
By C. R. Knowles
Superintendent Water Service, Illinois Central, Chicago

Water mains should not be laid under tracks where it can be avoided, and in laying out mains they should be designed to pass under as few tracks as possible, and then at right angles to the track and where they will not pass under frogs and switches.

The precautions necessary to prevent damage to pipe or track depend largely upon the character of the soil and the size of the pipe. If the ground is soft greater precautions will be necessary than where it is firm. With small pipe lines, say up to 8 in. in diameter, laid in firm ground usually no special protection is necessary other than to keep the pipe at a depth of at least 6 ft. below the ties and to tamp the earth firmly in place over the pipe. It is desirable to keep the trench as narrow as practicable, thus disturbing the natural ground as little as possible. In every case pipe should be laid so that no joints come directly under the track.

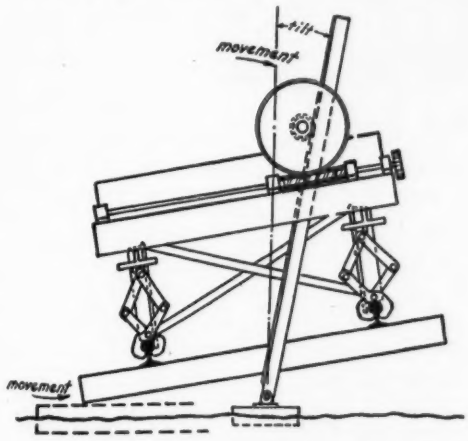
Where the ground is soft the pipe may be protected by passing it through a larger pipe, preferably of cast iron. Larger pipe lines may be protected by bridging over them with short bents supported on mud sills on each side of the pipe, or in firm ground by stringers under each rail. In extreme cases where the ground is very soft it may be necessary to drive piling on each side of the pipe and provide a trestle similar to a ballast deck trestle, as described in the proceedings of the American Railway Bridge and Building Association for 1921.

New and Improved Devices



A Rail Laying Machine Which Will Also Raise or Shift Track

THE Nordberg Machine Company, Milwaukee, Wis., has developed and placed on the market a self-propelled machine which conbines the function of a rail laying crane, a track shifter and a track



The Nordberg Machine Shifting Track

lifter. The various attachments for equipping it for the different tasks may be applied or detached quickly.

The machine consists essentially of a car body, 10 ft. long and 7 ft. wide, built up of heavy steel channels with riveted connections, which carries the engine and other mechanism. All of the parts subjected to heavy strains are of cast steel and the track wheels have wide chilled treads with axles running in roller bearings. The car is fitted with transverse wheels for removing it from the track, the machine being raised from the rails by its own mechanism to permit the insertion of the transverse rails.

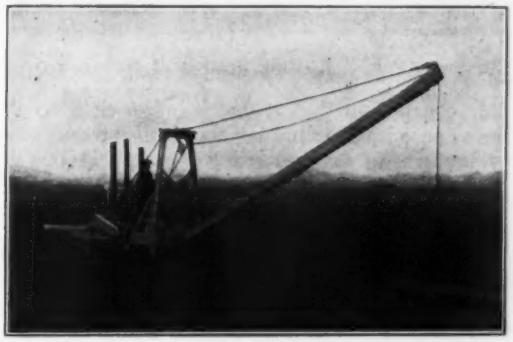
The boom of the crane is of trussed wooden construction, this design having been adopted to lower the first cost as well as to permit repairs to be made quickly and cheaply in case of accident. The boom and hoisting mechanism are said to be capable of handling rail of 150-lb. section with ample safety.

The shifting is accomplished by clamping the machine to the rails by a lever on the deck and lowering a spud with a bearing shoe between the ties, the spud being placed on the side of the center line of the track towards which the throw is to be made. The raising and lowering of the spud is controlled by a rack and pinion while a worm gear permits the spud to be moved transversely to the track to any point between the rails to control the amount of throw.

When the spud is in position further movement of the rack on the pinion raises the track on the side on which the spud is located until the weight of the machine on the tilted spud causes the track to move over to a new position, carrying a considerable section of track on both sides of the machine with it. The clamps are then released and the machine moves forward from 30 to 50 ft., according to conditions and the operation is repeated. The amount of the shift varies from 18 in. to 3 ft., depending on the weight of the track and the character and amount of the material around the ties.

When the track is to be raised the shoe of the shifting spud is replaced by a long shoe fitting between the rails of the tracks, to the ends of which are attached two leveling spuds, the shifting speed in this case being centered on the car. Where the shoe has a firm foundation it is said that a lift of from three to four feet may be made with one setting of the car. The leveling spuds are so arranged that the track may be raised level or with any desired amount of superelevation.

The power unit is a Hercules gasoline engine of 40 hp. capacity with a standard automatic clutch transmission, the application of the power being controlled by the operator by levers located conveniently within his reach. The transmission provides two traveling speeds in either direction: 7 miles per hour and 25 miles per hour, other speeds below the maximum being



The Nordberg Track Machine Laying Rail

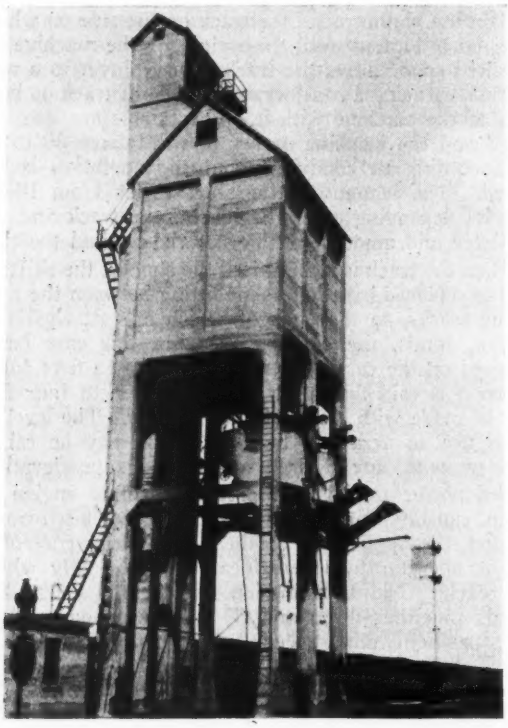
obtained by throttling the engine. The car has ample power for handling trailers for men or materials.

This machine has been used for raising and shifting track on the construction of the Skokie valley line of the Chicago, North Shore & Milwaukee. On this line, which is about 20 miles long, a large part of the grading

was done by laying a track on the ground on the center line of the double track and then raising to grade with the machine with gravel unloaded from work trains. After the embankment was raised to grade the construction track was shifted to its proper location as one of the main tracks by using the shifting device of the machine. The machine has also been used in the construction of new yards at Portsmouth, Ohio, and Williamson, W. Va., on the Norfolk & Western.

Celite Makes Concrete More Workable

CELITE or diatomaceous earth was used by the Ogle Construction Company of Chicago as an admixture in the concrete for eight coaling stations built by that company for the Southern Pacific in the southwest. Many obstacles are encountered in this type of construction that tend to impede the progress. Moreover, the requirements for quality are exacting because the presence of ground water makes it necessary to



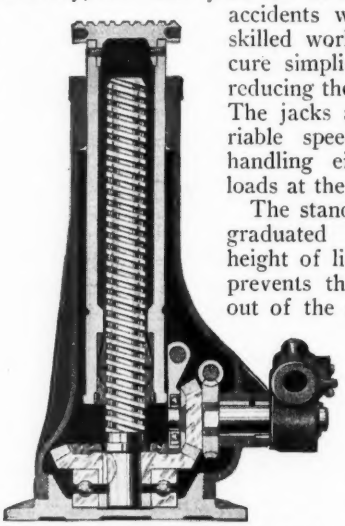
Southern Pacific Coaling Station at Bowie, Ariz.

provide concrete in the pit that is water-tight so as to insure against leakage through the floor and walls. The many theories of waterproofing concrete in this type of structure have been replaced by the theory that good concrete of sufficient thickness placed with a minimum of manipulation is the only concrete which can be depended upon to be permanently water-tight.

Experience with the use of Celite in coaling stations on the Southern Pacific showed that it added greatly to the workability with the use of a minimum quantity of water and resulted in obtaining a concrete with a smooth surface notwithstanding that no more than an ordinary amount of spading was done. The photograph shows the appearance of the station at Bowie, Ariz. The roof slab is four inches thick, the walls are six inches and eight inches thick and the upper walls are four inches thick. The mix was 1:2:4 and 2½ lb. of Celite furnished by the Celite Products Company of Los Angeles, was added throughout with each bag of cement. In the pit walls the coarse aggregate is smelter slag while ¾-in. limestone was used in the remainder of the structure.

A New Self-Lowering Jack

A NEW self-lowering jack of heavy-duty capacity, intended for use in bridge work or other places where closed control is necessary, has been developed and placed on the market by the Buda Company, Harvey, Ill. This jack has been designed to prevent accidents when operated by unskilled workmen and also to secure simplicity of parts, thereby reducing the costs of maintenance. The jacks are provided with variable speed control to permit handling either heavy or light loads at the desired rate of speed.

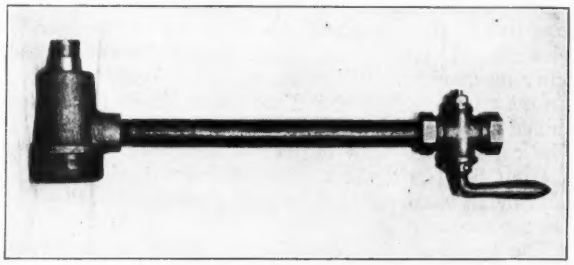


Sectional View of the Buda Self-Lowering Jack

The standard is marked with a graduated scale to show the height of lift and a positive stop prevents the standard being run out of the shell. A safety lever socket makes it impossible for the operator to damage the jack by operating the load-raising lever in the wrong direction and a safety lock is provided for locking the self-lowering device when it is necessary to leave the jack under load. These jacks are furnished in capacities ranging from 35 tons to 100 tons.

A Pneumatic Scaling Tool

A NEW compressed air tool for saving labor in painting bridges has been brought out by the Ingersoll-Rand Company, New York, in the form of a pneumatic scaler for use in removing rust, loose paint and scale from metal surfaces preparatory to painting. As seen in the illustration, it is a small hammer-shaped tool weighing about four pounds. The hammer, which works at right angles to the shaft, delivers ¾-in. strokes at a



The Scaling Tool with a Cock for Air Control

rate of 10,000 blows per minute. It is fitted with a bit having a face similar to that on a stone drill bit.

The scaler shown in the cut is provided with a cock for the control of the air supply but these tools are also to be had with a roll throttle if this is preferred. While these tools are handled in service in much the same way that one would hold a scaling hammer, it is possible to screw on a length of pipe so that the scaler may be used to reach surfaces that would otherwise be inaccessible by other means.

With the Associations

The American Railway Engineering Association

Within two weeks of the close of the annual convention the committees on outline of work and on personnel completed the committee organization and instructions went out to the committees on March 26, enabling them to start on their new work promptly. The appointments show many changes in the personnel of the committees, including seven new committee chairmen.

An outline of the subjects assigned to the various committees, together with the names of their chairmen, follow, with the subjects assigned for the first time shown in italics.

Roadway—Corrugated metal culverts; deformations of roadbed, in the light of data developed by the Special Committee on Stresses in Railroad Track, *with special reference to its effect on track maintenance;* improved methods for preventing corrosion of fence wire; specifications for steel fence posts; permanent roadbed construction, collaborating with the Committee on Track; *proper methods for policing the right-of-way, with special reference to appearance and economy of maintenance.* C. W. Baldridge, assistant engineer, A. T. & S. F., Chicago.

Ballast—Make critical review of the material now appearing in the literature of the association relating to ballast; ascertain existing views and practices of the railways; and recommend such changes as are found desirable; investigate the comparative values of various ballast materials, with special reference to drainage and its effect on costs for track maintenance, collaborating with the Committee on Roadway; make a critical study of the cause and effect of pumping joints in railway track *and the excess cost of maintenance resulting therefrom, with suitable recommendations for the removal of the cause,* collaborating with the committees on *Roadway* and on Track; *shrinkage of ballast materials.* Paul Hamilton, assistant chief engineer, C. C. C. & St. L., Cincinnati, Ohio.

Ties—Study anti-splitting devices *and make recommendation;* proper size hole for pre-boring *and make recommendation;* investigate and report on the extent to which the A. R. E. A. specifications are being adhered to; *make recommendations as to the renewal of switch-ties;* report on substitute ties; *methods of marking ties to indicate acceptance; methods of tie acceptance inspection; develop and recommend a traffic unit for use in comparing cross-tie life; report data on average ties renewed per mile of maintained track.* W. J. Burton, assistant valuation engineer, M. P., St. Louis, Mo.

Rail—Details of mill practice and manufacture as they affect rail quality; rail failures; transverse fissures; cause and prevention of rail battering; *economic value of different sizes of rail; reconditioning of battered or worn rail ends by the electric welding process, with especial reference to the effect upon the rail; drilling and spacing of holes in rails of all sections, and sizes of bolts for use with each section.* Earl Stimson, chief engineer maintenance, B. & O. Baltimore, Md.

Track—Make critical review of the material now appearing in the publications of the association relating to curve elevation; ascertain existing views and practices of the railways, and recommend such changes as are found desirable; detailed plans of switches, frogs, crossings and slip switches, including self-guarded frogs; track construction in paved streets; report on design and specifications for foundations under railway crossings; also proper methods for tie spacing and timbering under railway crossings; *report on methods of reducing rail wear on curves, with particular reference to oiling the rail or wheel flanges, collaborating with the Committee on Rail; make critical review of material in former proceedings with respect to the cause and effect of brine drippings, collaborating with the committees on Rail and on Iron and Steel Structures.* J. V. Neubert, engineer maintenance of way, N. Y. C., New York City.

Buildings—Specifications for concrete used in railway buildings, collaborating with the Committee on Masonry; artificial lighting for railway buildings; methods for improving the lighting, ventilation and convenient arrangement of railway structures, used in whole or in part for office purposes; rules and regulations for employees of the building department, collaborating with the Committee on Rules and Organization; *design and construction of water station buildings, collaborating with the Committee on Water Service;* permissible grades for ramps in railway buildings, *collaborating with the Committee on Yards and Terminals.* J. W. Orrock, engineer of buildings, C. P., Montreal, Canada.

Wooden Bridges and Trestles.—Simplification of grading rules and classification of timber for railway uses, *collaborating with the Committee on Rules and Organization, and other organizations dealing with this subject; prepare a revision of present specifications for treated and untreated timber piling, collaborating with the Committee on Wood Preservation; advantage of establishing supply yards for standard trestle timbers at various locations throughout the country; standardization and simplification of store stock and disposition of material reaching obsolescence, collaborating with other committees and organizations concerned.* W. E. Hawley, assistant engineer, D. M. & N., Duluth, Minn.

Masonry—Principles of design of plain and reinforced concrete for use in railway *buildings, bridges and culverts, collaborating with the committees on Buildings and on Iron and Steel Structures; progress being made in methods of concrete manufacture;* maintain contact with Joint Committee on Standard Specifications for Concrete and Reinforced Concrete and report to the association; specifications for foundations, including excavation, coffer-dams, piling, etc.; *general practices for waterproofing railway structures, collaborating with the committees on Buildings and on Iron and Steel Structures.* C. P. Richardson, engineer track elevation, C. R. I. & P., Chicago.

Grade Crossing Design, Protection and Elimination—Methods for apportioning the cost of highway improvements adjacent to railway rights-of-way: *(a) within incorporated limits of municipalities, and (b) without incorporated limits of municipalities; the comparative merits of various types of grade crossing protection, collaborating with the Committee on Signals and Interlocking;* study of excessive number of highway grade crossings of railways, with methods for their removal; economic aspects of grade crossing protection in lieu of grade separation; *use of center columns for highway grade separations; various types and locations of approach and warning signs for grade crossings, also the practices in the several states and Federal requirements, with a view to securing uniformity of practice and standards;* report on (a) laws and regulations affecting the apportionment of Federal aid; (b) the proper form and character of division of costs of separation of grades as between the railway, state, county, municipal or other corporation. Hadley Baldwin, chief engineer, C. C. C. & St. L., Cincinnati, Ohio.

Signals and Interlocking—Study of automatic train control, *collaborating with the committees on Track and on Yards and Terminals;* automatic *manual and non-operative* signals for highway crossing protection, collaborating with the committee on Grade Crossing Design, Protection and Elimination; signaling (designs, symbols, definitions, rules and instructions, construction and maintenance specifications), *collaborating with the Committee on Rules and Organization.* B. T. Anderson, superintendent of signals, C. & O., Richmond, Va.

Records and Accounts—Methods for reporting proportional increases in expenditures resulting from increased use of physical property, and also through increase of property investment, collaborating with the Committee on Economics of Railway Operation; develop units or methods for use in the control of maintenance expenditures from data taken from maintenance foremen's reports and used in preparing reports for the I. C. C., collaborating with the committees on Economics of Railway Labor and on Economics of Railway Operation; use made of aerial surveys and results obtained therefrom; *collaborate with other committees in the preparation and design of forms pertinent to their work;* report progress upon changes or revisions in I. C. C. classification accounts. J. H. Hande, accounting engineer, B. & O., Baltimore, Md.

Rules and Organization—Study and report on rules for the guidance of employees of the maintenance of way department, including therein: *(a) duties of motor car operators and maintainers, (b) rules for dressing ballast, and (c) rules*

for maintenance of bridges and other terminal structure, collaborating with the proper standing committees; study the titles below the rank of division engineer, which are employed to designate positions of corresponding rank in maintenance of way service, and make recommendations that will promote uniformity in nomenclature. W. C. Barrett, trainmaster, L. V., Sayre, Pa.

Water Service—Study federal and state requirements with respect to drinking water supplies; causes and extent of pitting and corrosion of locomotive boiler tubes and sheets, giving consideration to quality of water, character of metals, methods of manufacture, and types of boiler construction; relative cost of impurities in locomotive boiler water and establish values for water treatment; *also report on the following phases of the subject*: (*a*) *comparative value of various reagents used in water treatment, including sodium aluminate,* (*b*) *foaming of locomotive boilers, with special reference to the influence of suspended matter, and* (*c*) *relative insulating qualities of carbonate and sulphate scale, and the cost of treatment for their removal; various types of hydrants for coach yard and general service, with special reference to reliability and low maintenance cost, and methods for supplying water to coaches, with a view of recommending standard practice, collaborating with the Committee on Yards and Terminals; most suitable kinds and types of pipe for small service lines (three inches and under) with particular reference to the use of prepared joint cast iron, copper or brass pipe as substitutes for steel and wrought iron pipe;* use of gravity and pressure filters *and make final report thereon;* methods for disposal of sludge at water softening plants *and make final report thereon;* design and maintenance of track pans for locomotives, *collaborating with the Committee on Economics of Railway Operation, and make final report thereon;* best methods to be used in obtaining successful wells in fine sand formation, *and make final report thereon;* proper spacing of water stations, and capacity of engine tenders, collaborating with the Committee on Economics of Railway Operation, *and make final report thereon.* C. R. Knowles, superintendent of water service, I. C., Chicago.

Yards and Terminals—Study of design and operation of: (*a*) *large passenger terminals, and* (*b*) *subterminals; design and operation of freight terminals, with particular reference to convenience and economy of operation; proper width of teamway for team yards, freight houses, etc.; specfications for various types of scales used in railway terminals; disposition for various types of scales used in railway terminal; disposition of track scales which have been removed by reason of inadequacy, obsolenscence or inaccuracy; proper requirements for practical design and construction of humps in terminal yards, collaborating with the Committee on Economics of Railway Operations; proper spacing of delivery tracks.* J. E. Armstrong, assistant engineer, C. P., Montreal, Canada.

Iron and Steel Structures—Make final report upon proposed specifications for steel highway bridges; feasibility of electric welding of connections in steel structures; undertake the testing and study the behavior of bridge pins under test loads; undertake the testing and study the behavior of steel columns under test loads; investigate the desirability of using copper-bearing steel for structural purposes; *influence of the dead load upon the impact from moving loads on bridges.* B. R. Leffler, negineer of bridges, N. Y. C., West of Buffalo, Cleveland, Ohio.

Economics of Railway Location—Study of economics of grade revision as affected by the introduction of electric locomotitives, collaborating with the Committee on Electricity; relative merits of a 0.4 per cent ruling grade as compared with a 0.3 per cent grade; relative merits of increasing tonnage by the reduction of ruling grades or by the introduction of more powerful locomotives, including the consideration of momentum grades and the availability of the locomotive booster; locomotive capacity, giving special attention to oil burning locomotives, collaborating with the appropriate committee of Division V-Mechanical, A. R. A. F. R. Layng, assistant chief engineer, B. & L. E., Greenville, Pa.

Wood Preservation—Definition of terms used in wood preservation; service test records for treated ties; piling used for marine construction; effect of preservative treatment with: (*a*) *creosote and petroleum,* (*b*) *zinc chloride and petroleum, and* (*c*) *air-seasoned Douglas fir.* F. C. Shepherd, chief construction engineer, B. & M., Boston, Mass.

Electricity—Subjcet of inductive co-ordination as well as representation on the American Committee on Inductive Co-ordination; *tidal water power development on Passamaquoddy bay* and the St. Lawrence river water power development when actual construction is in progress; *also the water power development sponsored by the Aluminum Company of Canada on the Saguenay river;* continue representation on the American Committee on Electrolysis without commitment as to subscription or dues; collaborate with the United States Bureau of Standards in the revision of the National Electrical Safety Code and other codes of similar character; study of electric light, power supply and trolley lines crossing railways, with a view of keeping the association informed with regard to changes which may be desirable in the adopted specifications to make them conform more nearly with the revisions of Part II of the National Electrical Safety Code, prepared by the United States Bureau of Standards, and with the requirements of the public service commissions and other regulatory bodies of the various states; continue the state representatives and their alternates; *revise and keep up-to-date the transmission line specifications previously adopted; study of design and construction for catenary supported working conductors;* study of economics of railway location as affected by electrial operation, collaborating with the Committee on Economics of Railway Location; study of friction and rubber insulating tapes, *with a view of keeping the specifications up-to-date; study insulators with a view of keeping up-to-date the specifications previously adopted; report on the tensile strength of strain type insulators measured over a short period of time compared with the tensile strength measured over a long period of time;* revise the tables showing third rail clearances and tables showing overhead working conductor clearances and extend them to include data giving the location of the third rail above the plane of the running rails and beyond the gage line; protection of oil sidings from danger due to stray currents with a view of keeping up-to-date the rules previously adopted; specifications for track and third rail bonds with especial reference to: *(a) developing standard specifications for measurement of welded bond resistance, (b) securing data on current carrying capacity of bonds, (c) the study of bond design and practice for the purpose of determining to what extent standardization is practicable, without interfering with the progress of the art, with a view to developing specifications, and (d) means for attaching bonds to managanese track rails; revise and keep up-to-date the incandescent lamp schedule; study of flood lighting of classification yards and for other railroad purposes, collaborating with the Committee on Yards and Terminals; design of indoor and outdoor substations, collaborating with the Committee on Buildings.* Edwin B. Katte, chief engineer, electric traction, N. Y. C., New York City.

Uniform General Contract Forms—Study of form of agreement for joint use of freight terminal facilities; form of agreement for use of railway property for public highways; form of construction contract for particular items of work; form of contract for cost-plus percentage work. J. C. Irwin, valuation engineer, B. & A., Boston, Mass.

Economics of Railway Operation—Methods for obtaining a more intensive use of existing railway facilities, with particular reference to increasing carrying capacity: (a) without material additional capital expenditures, and (b) with due regard to reasonable increases in capital expenditures consistent with traffic requirements; methods or formulas for the solution of special problems relating to more economical and efficient railway operation; most economical make-up of track to carry various traffic densities; develop suitable units for operating and equipment statistics, *required by Interstate Commerce Commission, to be used in cost comparisons of transportation, equipment and roadway maintenance, with necessary additions thereto, collaborating with the committees on Records and Accounts and on Economics of Railway Labor;* determine what volume or other conditions of business or service justifies a change from flat switching to the hump method in any given yard, collaborating with the Committee on Yards and Terminals; problems of railway operation as affected by the introduction of motor trucks and bus lines, *with particular reference to its effect upon branch or feeder lines.* J. M. Farrin, special engineer, I. C., Chicago.

Economics of Railway Labor—Study of stabilization of employment in the maintenance of way department; methods for securing greater efficiency and economy by the use of labor-saving devices in railway track maintenance; standardization of parts and accessories for railway maintenance motor cars; equating track values for labor distribution. C. C. Cook, maintenance engineer, B. & O., Baltimore, Md.

Committee on Shops and Locomotive Terminals—Study of design for: (a) coaling stations, (b) typical locomotive repair shops, (c) storehouses, and (d) shops and locomotive terminals, *with particular reference to convenience and economy of operation,* collaborating with the Committee on Buildings; proper methods for the safe and convenient storage of crude and fuel oils, *collaborating with the Committee on Electricity.* F. E. Morrow, assistant chief engineer, C. & W. I., Chicago.

Co-operative Relations with Universities—A greater interest upon the part of railroad officers in assisting the universities to develop the best possible methods for the technical courses;

a better means of bringing to the universities the results of our deliberations, where such can be made of value to them; a better means of bringing to the attention of the railroads the benefits of a technical education, thereby acquainting them with the qualifications of graduates of these courses for initial service in subordinate positions, and at the same time providing material from which men may be drawn for higher positions as they demonstrate their fitness; a means of stimulating a greater interest in the science of transportation among engineering students who may be inclined toward this branch of industry; a means whereby the facilities of the universities may be made more directly available for the research work of the association by co-operative effort between their laboratories and the committees of the association; a means whereby the universities may be better enabled to educate the students and the public regarding the value of transportation to the nation as a whole; a means of stimulating a greater interest among university officials in the study of transportation and economics and impressing them with the importance of experienced men for such teaching. Robert H. Ford, assistant chief engineer, C. R. I. & P., Chicago.

Special Committee on Stresses in Railroad Track—Stresses in railroad track. A. N. Talbot, professor of municipal and sanitary engineering, and in charge of theoretical and applied mechanics, University of Illinois, Urbana, Ill.

Special Committee on Standardization. W. C. Cushing, engineer of standards, Pennsylvania, Philadelphia, Pa.

Special Committee on Clearances. B. R. Leffler, engineer of bridges, N. Y. C., Cleveland, Ohio.

The Material Market

ALTHOUGH the volume of purchases has continued moderate throughout the month of March and business forecasts indicate rather conservative buying in the immediate future, prices in the iron and steel market have taken on a steadier tone than was manifest throughout January and February. Price concessions have not entirely disappeared but none has been indicated in items of direct interest to the maintenance of way department, and as will be noted in the table appearing in this column, there has been a moderate stiffening in the case of structural shapes, steel bars and cast iron pipe.

Production has continued at a substantial rate and is estimated at close to 90 per cent of capacity and according to recent reports is in excess of demand, with the result that there has been a further narrowing of the margin between the placing of orders and deliveries. This is evidenced by a further reduction in the unfilled orders on the books of the United

Prices Per 100 Lb.

	February				March			
	Pittsburgh		Chicago		Pittsburgh		Chicago	
Track spikes	$2.80 to $3.00			$2.90	$2.80 to $3.00			$2.90
Track bolts	3.90 to 4.25			3.90	3.90 to 4.25			3.90
Angle bars		2.75		2.75				2.75
Tie plates, steel		2.35		2.35		2.35		2.35
Boat spikes		3.25		3.25		3.25		3.25
Plain wire		2.40		2.45		2.40		2.45
Wire nails, keg	2.50 to 2.55			2.60		2.55		2.60
Barb wire, galv.		3.25		3.30		3.25		3.30
C. I. pipe, 6 in. 12 in., ton			43.70 to	45.20			42.20 to	45.20
Plates	1.80 to 1.90		2.00 to	2.10	1.80 to 1.90		2.00 to	2.10
Shapes	1.80 to 1.90		2.00 to	2.10		1.90	2.00 to	2.10
Bars, soft steel	1.85 to 1.90		2.00 to	2.10		1.90	2.00 to	2.10
Rivets, struc	2.30 to 2.40			2.60	2.30 to 2.40			2.60
Con. bars, billet		1.90				1.90		
Con. bars, rail	1.75 to 1.80		1.90 to	2.00	1.70 to 1.80		1.90 to	2.00
Rails, per gross ton f.o.b. mills				43.00				43.00

States Steel Corporation which totalled 3,597,119 tons on February 28 as compared with 3,800,177 tons on January 31 and 4,616,822 tons on February 28, 1926. Rail production is given as about 85 per cent of capacity and rolling on some orders is now nearing completion. There has also been some speeding up in shipments, owing to a desire on the part of certain railroads to take advantage of the current mild weather for advancing their renewal programs.

Current rail orders are in small volume, as is to be expected at this season. Recent miscellaneous orders include that of the Detroit & Toledo Shore Line for a total of 1,500 tons, divided between the Illinois Steel Company with 1,000 and the Bethlehem Steel Company with 500 tons. Orders for about 5,000 tons of rails are expected shortly from roads in New England which are also in the market for $100,000 worth of frog and switch material.

The market for track accessories in March was

Per Gross Ton

	February	March
Relaying rails (including angle bars)	$26.00 to $31.00	$26.00 to $31.00
Rails for rerolling	15.75 " 16.25	15.50 " 16.00
Rails less than 3 ft. long	16.50 " 17.00	16.50 " 17.00
Frogs and switches cut apart	14.50 " 15.00	14.50 " 15.00
Steel angle bars	15.25 " 15.75	14.75 " 15.25

not as active as it was during the two preceding months. The Chesapeake & Ohio ordered 2,500 tons of tie plates and has made inquiries for 10,000 kegs of spikes and bolts on which no orders have yet been placed. A western road has ordered 800 tons of iron tie plates. The Pennsylvania is in the market for 7,000 kegs of spikes, 800 kegs of bolts, 1,500 tons of angle bars and 1,100 tons of tie plates. The production of spikes, bolts and angle bars in the Chicago territory is rated at 60 per cent of capacity and that of tie plates at 85 per cent.

A change in the manner of quoting bolts, under which prices of bolts will be given per piece instead of per 100 lb., has been adopted by the manufacturers, effective April 1, and it is understood that track bolt prices will be quoted on this basis in the future.

The scrap market is quiet and the prices on some items are lower than those quoted last month. No railroad tonnages of any volume have been noted for several weeks.

With the advent of the active season in building construction, the lumber market has taken on new life, but is still below normal. Orders taken by the Southern pine mills during the first three weeks of

Southern Pine Mill Prices

	February	March
Flooring, 1x4, B and B, flat	$41.67	$44.70
Boards, 1x8, No. 1	35.58	35.60
Dimension, 2x4, 16, No. 1, comomn	23.92	26.57
Dimension, 2x10, No. 1, common	28.45	28.04
Dimension, 2x4, 16, No. 2, common	23.10	22.63
Dimension, 2x10, No. 2, common	24.26	23.57

Douglas Fir Mill Prices

	February	March
Floorings, 1x4, No. 2, clear flat	$26.00	$26.00
Boards, 1x8, 6 to 20, No. 1, common	16.00	16.00
Dimension, 2x4, No. 1, common	17.00	17.00
Dimension, 2x10, 16, No. 1, common	17.00	17.00
Timbers, 6x6 to 8x8, No. 1	20.00	20.00
Timbers, 3x12 to 12x12, rough	18.00	18.00

March totalled more than for the corresponding weeks of 1926 and 1925 and the volume of unfilled orders on March 18 was considerably greater than on January 1, but the average on the latter date of 2,035,066 ft. b. m. per mill is to be compared with 2,375,508 ft. b. m. for March 19, 1926. Douglas fir mills also report increased business but are suffering from a weakness in the demand from the Atlantic coast. Prices show no marked change from the quotations appearing in last month's issue, as will be noted in the table of lumber prices.

Prices of Portland cement have remained stationary since the reduction at New York from $2.15 to $2.03 f. o. b. docks. The prices given below are per barrel in carload lots, not including package.

New York	$2.03	Minneapolis	$2.22
Pittsburgh	2.04	Denver	2.85
New Orleans	2.40	Dallas	2.05
Chicago	2.05	San Francisco	2.31
Cincinnati	2.32	Montreal	1.15

Railway News Briefly Told

According to a report compiled by the Bureau of Explosives of the American Railway Association the railroads of the United States and Canada handled more than 2,000,000 freight cars loaded with high explosives, inflammable liquids and other dangerous material with a loss of only three lives.

One important part of the construction of the Cascade tunnel on the Great Northern was completed on March 4, when the heading being driven westward from the eastern portal at Berne and the heading driven eastward from a shaft at Mill Creek were holed through, the distance being 12,738 ft. The total length of the tunnel will be 41,143 ft.

The president of the St. Louis Board of Public Service, the city engineer of bridges and buildings and the assistant city counselor of St. Louis have asked the Missouri Legislature to repeal the law which requires a 22-ft. vertical clearance at all bridges, viaducts and other structures over railroad tracks, contending that an 18-ft. clearance is sufficient for safety.

The Canadian National branch line program, which has been presented to the Canadian Parliament by Charles A. Dunning, minister of railways and canals, provides for the construction of 494 miles of road at an estimated cost of almost $21,000,000. Of the proposed mileage, 104 miles are in Quebec, 17 miles in Ontario, 316 miles in Saskatchewan and 57 miles in Alberta.

Revenue car loadings for the week ended March 12 amounted to 1,005,715 cars, an increase of 38,290 over the loadings for the corresponding week last year and of 79,596 over the same week in 1925. The increase was due principally to heavier loadings of coal which totalled 220,179 or 31,345 more than the same week in 1926. This is the first time that freight loadings in any one week have reached the million-car mark at this season of the year. In 1926, this total was not reached until May and in the previous year it was June before a million-car week was recorded. The cumulative total for the first 11 weeks of the current years is 10,349,326, as compared with 10,038,022 and 9,938,159 for the corresponding periods in 1926 and 1925, respectively.

The Lewiston (Idaho) Commercial Club has filed a complaint with the Interstate Commerce Commission, asking that body to order an extension of the Oregon Short Line from Homestead, Ore., through Clarkston, Idaho, to a connection with the line operated by the Camas Prairie at Lewiston, naming as defendants the Oregon Short Line, the Camas Prairie, the Oregon-Washington Railroad & Navigation Company, the Union Pacific and the Northern Pacific. The complaint states that the proposed line would provide a water grade from Huntington, Ore., and all points east to Portland, Ore., and all points north and west. The commission is also asked to require the defendants to "disclose what, if any, agreements they have in restraint of construction in Central Idaho and eastern Washington."

The average age at death from sickness among members of the relief department of the Chicago Burlington & Quincy has increased from 49 yr., 9 mo. in 1890 to 57 yr., 6 mo. in 1920. In the latter year only 39 per cent of the total benefits were paid on account of accidents, as compared with 60 per cent in 1906. On the other hand, deaths due to accidents while off duty have increased greatly during the same period, 16 members losing their lives in accidents while off duty in 1926, or three times as many as in 1906. Of these fatalities, 10 were due to automobile accidents. The report calls attention to the value of co-operation in matters concerning sanitation, personal hygiene, proper food and water and other factors affecting health, stating that employees lost between 400,000 and 500,000 days' wages during 1926 because of sickness.

The nomination of John Williams of Oakland, Cal., as a member of the United States Board of Mediation for the term ending December 31, 1930, to succeed Hywel Davis, deceased, was sent to the Senate by President Coolidge on February 24. Mr. Williams was for many years an officer of the Amalgamated Association of Iron, Steel and Tin Workers and since 1919 has been industrial manager of the Pacific Coast Steel Company.

On February 28, the 100th anniversary of the granting of the charter of the Baltimore & Ohio Railroad Company, was celebrated by a dinner party and pageant at the Lyric theatre in Baltimore. President Daniel Willard presided and introduced the two speakers of the evening, Mayor Jackson of Baltimore and Newton D. Baker, formerly secretary of war. The pageant, which was witnessed by 1,800 persons, comprised a graphic reproduction of various episodes in the early history of the railroad, including the laying of the first stone of the railroad, and the famous race between Peter Cooper's Tom Thumb engine and a car drawn on rails by a horse. President Willard announced the plan for a pageant and extensive exhibition to be held on the grounds of the Baltimore & Ohio at Halethorpe, Md., in September.

The Interstate Commerce Commission cannot be prevented from publishing the figures for final valuation of any railroad as determined by the Bureau of Valuation. This is the unanimous decision of the United States Supreme Court in reversing the decision of the district court of the Southern district of California in a suit brought by the Los Angeles & Salt Lake to enjoin the commission from publishing its final value for that property. The commission's figure is $45,000,000, whereas the railroad claims that the valuation for rate-making purposes should be $70,000,000. The decision is based on the conclusion that the publication of a valuation is not an "act" but "merely the formal record of conclusions reached." This decision does not in any way affect the right of action on the part of a railroad in any case where the commission makes use of its valuation figures as evidence in a rate case, recapture proceedings or otherwise.

The annual summary of line and track mileage of the Pennsylvania system recently completed shows that for all of the operating companies included within the system, the total line mileage at the close of the year was 11,640.66 miles. In addition, there were 4,363.11 miles of second track, 939.69 miles of third track, 710.10 miles of fourth track, and 10,386.93 miles of sidings, which brings the total of all tracks to 28,040.49 miles. In maintaining this extensive mileage of tracks during 1926, 217,995 tons of steel was required for rail renewals and 5,381,042 cross ties. The rail renewals for the year represented an increase of 14,323 tons over the previous high record established in 1925 and reflect in particular the increased use of heavy sections, especially that weighing 130 lb. to the yard. The most recent figures in this regard show that more than 60 per cent of the Pennsylvania's 4,441 miles of main lines is laid with 130-lb. rail and more than 5 per cent with 125-lb. rail.

Personal Mention

General

A. C. Shields, assistant general manager of the Denver & Rio Grande Western with headquarters at Denver, Colo., whose railway experience embraces engineering and maintenance of way, has been promoted to general manager, with headquarters at the same place to succeed **I. H. Luke,** who has retired. Mr. Shields was born in Iowa and was educated at Iowa State College. He entered railway service in 1898 in the engineering department of the Chicago, Rock Island & Pacific, serving in various capacities until March, 1913, when he was promoted to division engineer, with headquarters at Little Rock, Ark. He was transferred to Trenton, Mo., in 1916, and left the Rock Island in August, 1923, to become engineer maintenance of way of the D. & R. G. W., with headquarters at Denver. He was promoted to assistant general manager in 1925, which position he was holding at the time of his recent promotion.

Engineering

Harold Rindal, formerly district engineer of the British Columbia district of the Canadian Pacific, with headquarters at Vancouver, B. C., has been appointed chief engineer of the Pacific Great Eastern, with headquarters at Vancouver.

R. E. Sherer, assistant engineer on the Minneapolis, St. Paul & Sault Ste. Marie, with headquarters at Enderlin, N. D., has been appointed division engineer on the Duluth South Shore & Atlantic, with headquarters at Marquette, Mich.

Arthur J. Gayfer, division engineer of the Melville division of the Saskatchewan district of the Canadian National, with headquarters at Melville, Sask., has been appointed division engineer of construction on the Dunblane extension, with headquarters at Dunblane, Sask.

J. P. Mack has been appointed division engineer of the Los Angeles division of the Los Angeles & Salt Lake unit of the Union Pacific system, with headquarters at Los Angeles, Cal., succeeding **R. L. Adamson,** whose promotion to assistant chief engineer was noted in the March issue. **Frank Strong,** terminal engineer, with headquarters at Los Angeles, has been appointed industrial engineer, with headquarters in the same city and the position of terminal engineer has been abolished.

L. P. Rossiter, division engineer on the Lehigh Valley, with headquarters at Buffalo, N. Y., has been promoted to assistant engineer of grade crossing work in charge of the work in the state of New York. **A. B. Shimer,** track supervisor at Easton, Pa., has been promoted to division engineer, with headquarters at Auburn, N. Y., to replace **H. M. Fearon,** who has been transferred to Hazelton, Pa., where he succeeds **R. E. Patterson,** transferred to Sayre, Pa., to take the place of **E. J. Cullen,** who has been tansferred to Buffalo to succeed Mr. Rossiter.

Elmer O. Davis has been appointed division engineer of the Colorado division of the Union Pacific, with headquarters at Denver, Colo., to succeed **S. H. Osborne,** whose promotion to engineer maintenance of way was noted in the March issue. Mr. Davis was born on May 16, 1883, at Burlington Junction, Mo., and was educated at the University of Nebraska, where he graduated in 1905. He entered railway service as a section laborer on the Chicago, Burlington & Quincy during his school vacations and after completing his college course became an assistant foreman on new track construction on the Burlington at Guernsey, Wyo. On February 1, 1906, he entered the engineering department of the Burlington as a rodman and later was promoted to assistant engineer. On August 15, 1906, he became a laborer in the track department on the Union Pacific, subsequently being promoted to section foreman. On March 1, 1907, he left the track department to become a rodman on maintenance work on the U. P. at Denver, Colo. He was promoted to instrumentman in May, 1907, and to assistant engineer in May, 1909. From November 26, 1916, to April, 1919, he was office engineer at Denver, returning to his position as assistant engineer on the latter date, which position he was holding at the time of his recent promotion to division engineer.

A. R. Wilson, whose promotion to engineer of bridges and buildings on the Pennsylvania, with jurisdiction over the eastern portion of the system, was noted in the March issue, was born in January, 1877, at Bordentown, N. J., and graduated from Drexel Institute, Philadelphia, Pa., in 1896, as a mechanical engineer. He entered railway service in July, 1902, as a draftsman in the bridge department of the Pennsylvania, specializing in the design of movable bridges, turntables and transfer bridges. He was promoted to assistant engineer in March, 1920, and to assistant engineer of bridges in May of the same year. This was followed by his promotion to assistant engineer of bridges and buildings in January, 1923, which position he was holding at the time of his recent advancement to engineer of bridges and buildings.

A. R. Wilson

Robert Farnham, whose promotion to chief engineer of the Philadelphia improvements of the Pennsylvania was noted in the March issue, was born on December 19, 1877, at Washington, D. C. He was graduated from Lehigh University in 1899 and entered the service of the Pennsylvania in March, 1903, as a transit man on an engineering corps. In August of the same year he was promoted to assistant engineer in charge of construction for the Pennsylvania in connection with the building of the Union Station and grade crossing elimination at Washington, D. C. On the completion of this work in March, 1910, he was transferred to the office of the engineer of bridges and buildings at Philadelphia, as assistant engineer in charge of the drafting room. In 1913 he was promoted to assistant to the engineer of bridges and buildings and, in 1916, to assistant engineer of bridges and buildings, having charge of the design and erection of steel and masonry bridges on the Pennsylvania lines east of Pittsburgh, Pa., and Erie. He was promoted to engineer of bridges and buildings in April, 1923, which position he was holding at the time of his recent promotion to chief engineer of the Philadelphia improvements.

Robert Farnham

W. R. Pearson, chief land appraiser on valuation for the Louisville & Nashville, with headquarters at Louisville, Ky., has been promoted to valuation engineer, with headquarters at that city. Mr. Pearson entered the service of the L. & N. in October, 1902, as a rodman and was promoted successively to draftsman, topographer and instrumentman until 1906, when he was promoted to locating engineer.

After leaving railroad service for a year, he returned to the L. & N. as an assistant engineer in the office of the chief engineer of construction. Mr. Pearson served as a captain of engineers with the American Expeditionary Forces during the World War, and at the end of the war was commissioned as a major in the Engineer Reserve Corps. In October, 1920, he was appointed chief land appraiser on valuation work, working under the direction of the real estate agent, which position he was holding at the time of his recent promotion to valuation engineer.

Charles J. Rist, division engineer on the Pere Marquette, with headquarters at Saginaw, Mich., has been promoted to engineer maintenance of way, a newly created position, with headquarters at Detroit, Mich.

G. A. Noren, designing engineer of the New York Central, Buffalo and East, with headquarters at New York, has been promoted to engineering assistant to the vice-president, with the same headquarters, and **E. A. Dougherty** has been appointed designing engineer to succeed him. Mr. Noren was born on April 6, 1886, at New Britain, Conn., and was graduated from the University of Pennsylvania in 1910. He entered railway service in June of the same year as a rodman on the Pennsylvania and in October, 1911, became an assistant engineer for the Monterrey Railway, Light & Power Company, Monterrey, Mex., later entering private practice in general engineering at Monterrey. He re-entered railway service in 1912 as an assistant engineer on four-tracking work on the Hudson river division of the New York Central, and in February, 1916, became assistant engineer on the preliminary and location of the Hudson River Connecting (now a part of the New York Central). He was promoted to resident engineer on station improvements at Poughkeepsie, N. Y., in December, 1916, and in April of the following year was promoted to assistant district engineer of the Eastern district. Mr. Noren was promoted to engineer of grade crossings, with headquarters in New York, in February, 1920, and in 1924 he was promoted to designing engineer, with the same headquarters, which position he was holding at the time of his recent promotion to engineering assistant to the vice-president.

G. A. Noren

Track

W. M. Patterson, section and extra gang foreman on the River division of the St. Louis-San Francisco has been promoted to roadmaster, with headquarters at Chaffee, Mo., to succeed A. Terry, who has been assigned to other duties.

Reuben A. Lambert, whose promotion to roadmaster on the Chicago, Milwaukee & St. Paul, with headquarters at Cedar Falls, Wash., was noted in the February issue, was born on October 17, 1892, at Dakota, Minn. He entered railway service as a waterboy on the Chicago, Milwaukee & St. Paul in 1907 at his home town and became a section laborer at Terry, Mont., in 1908. He was promoted to section foreman on March 1, 1920, serving in that capacity and as assistant yard foreman and yard foreman until the time of his recent promotion.

Arthur Jung, district roadmaster on the Union Pacific, with headquarters at Marysville, Kan., has been promoted to general roadmaster, with headquarters at Cheyenne, Wyo., to succeed **O. C. Wilkes,** who has transferred to Omaha, Neb., to replace **G. H. Warfel,** whose promotion to assistant to the general manager, with headquarters at Omaha was noted in the January issue. **J. S. Carroll,** extra gang foreman on the Wyoming division, with headquarters at Cheyenne, Wyo., has been promoted to district roadmaster, with headquarters at Marysville, Kan., to succeed Mr. Jung. **W. H. Thomson,** section foreman, has been promoted to district roadmaster, with headquarters at Green River, Wyo., to succeed **O. J. Bostrum,** who has been assigned to other duties.

P. J. Carney, roadmaster on the Northern Pacific, with headquarters at East Grand Forks, Minn., who has been on leave of absence on account of illness as noted in the January issue, has resumed his duties, replacing **S. McCarthy,** who was acting roadmaster during his absence and who has resumed his former position as section foreman.

D. B. Cellar, assistant supervisor on the Pittsburgh division of the Pennsylvania, with headquarters at East Liberty, Pa., has been promoted to supervisor on the Renovo division, with headquarters at Erie, Pa., succeeding **W. G. Kemmerer,** whose appointment as master carpenter on the Eastern division is noted elsewhere in this issue and **C. H. Frick,** assistant supervisor on the Pittsburgh division, with headquarters at Derry, Pa., has been promoted to supervisor, with headquarters at DuBois, Pa., to succeed **P. X. Geary,** whose appointment as master carpenter on the Renovo division is noted elsewhere in this issue. **J. J. Cassidy** has been appointed assistant supervisor on the Monongahela division, with headquarters at Brownsville, Pa., where he replaces **J. C. Groft,** who has been transferred to the Pittsburgh division, with headquarters at East Liberty, Pa., to succeed Mr. Cellar. **L. O. Shanely** has been appointed assistant supervisor on the Conemaugh division, with headquarters at Freeport, Pa., where he replaces **J. L. Huron,** who has been transferred to the Pittsburgh division, with headquarters at Derry, Pa., to succeed Mr. Frick. **G. B. Buffington** has been appointed assistant supervisor on the Buffalo division, with headquarters at East Aurora, N. Y., a newly created position.

J. J. Culliton, whose promotion to general roadmaster of the Kansas division of the Union Pacific, with headquarters at Kansas City, Mo., was noted in the January issue, entered the service of the Union Pacific as an assistant extra gang foreman on the Kansas division on January 2, 1905, serving in that capacity and as section foreman until March 1, 1911, when he was transferred to the Nebraska division as foreman of a rail laying gang. On January 1, 1913, he was promoted to general foreman on construction, remaining in that position until the completion of the work when he resumed his duties as rail laying foreman. On June 1, 1919, he was promoted to general foreman of the Armstrong yards and on July 25, 1920, was further promoted to roadmaster of the Eastern district of the Kansas division, with headquarters at Kansas City, Mo., which position he was holding at the time of his recent promotion to general roadmaster.

J. J. Culliton

Stanley A. Miller, yard foreman at Edgemont, S. D., has been promoted to roadmaster on the Casper division of the Chicago, Burlington & Quincy, with headquarters at Casper, Wyo., where he will have charge of the line from Casper to Bonneville, Wyo., replacing **T. V. Ross,** who has been transferred to the line from Bonneville to Greybull, with headquarters at Greybull, Wyo., succeeding **S. H. Weckworth,** who will have charge of the line from Greybull to Fromberg, Wyo., with the same headquarters, taking the place of **J. B. Baker,** who has been transferred to Alliance, Neb., to succeed **James Emerson,** deceased. **J. R. Caldwell,**

section foreman at St. Joseph, Mo., has been promoted to roadmaster on the Chariton-St. Joseph line on the St. Joseph division, with headquarters at Albany, Mo., where he succeeds **R. Double,** who has been transferred to the Creston-Amazonia line on the Creston division, with headquarters at Creston, Iowa, replacing **J. Spargur,** resigned.

Mr. Miller was born on January 19, 1893, at Mendota, Ill., and entered railway service on March 29, 1916, as a section laborer on the Chicago, Burlington & Quincy at Orella, Neb. He was promoted to section foreman on the Alliance division in June, 1923, and was appointed foreman of the yard at Deadwood, S. D., on January 1, 1924, being transferred to the yard at Edgemont, S. D., on July 1, 1924, which position he was holding at the time of his recent promotion to roadmaster.

Bridges and Buildings

F. D. Whaley has been appointed master carpenter on the Chicago, Rock Island & Pacific, with headquarters at Cedar Rapids, Iowa, to succeed **S. P. Perkins,** who has been assigned to other duties.

W. G. Kemmerer, supervisor on the Renovo division of the Pennsylvania, with headquarters at Erie, Pa., has been appointed master carpenter of the Eastern division, with headquarters at Alliance, Ohio, where he succeeds **M. F. Hunter,** deceased. **P. X. Geary,** supervisor on the Allegheny division, with headquarters at DuBois, Pa., has been appointed master carpenter on the Renovo division, with headquarters at Erie, Pa., succeeding **E. A. Roberts,** whose transfer to the C. & P. division was noted in the March issue.

Purchasing and Stores

V. J. Crow, has been appointed division storekeeper on the Southern, with headquarters at Columbia, S. C., to succeed **J. B. Lowd,** who has resigned. **R. A. Livengood,** division storekeeper at Charlotte, N. C., has been appointed storekeeper of the Charlotte roadway shop, with headquarters at the same place, succeeding **J. H. Logan,** transferred.

Obituary

George E. Bitz, general bridge inspector on the New York Central, Lines West, with headquarters at Cleveland, Ohio, died on March 13, after an illness of three months.

George M. Brown, at one time chief engineer of the Saginaw district of the Flint & Pere Marquette, and later engineer of water service of its successor, the Pere Marquette, died at his home at Detroit, Mich., on February 11. Mr. Brown was born on March 1, 1843, in Rutland township, Tioga county, Pa., and after attending Wellsboro academy served in the Civil war in the Fifth Pennsylvania Volunteers. He was wounded in the seven-day battle before Richmond, Va., in 1862, and after his discharge from a government hospital in 1867, he entered the engineering department of the Flint & Pere Marquette. In 1869 he was promoted to resident engineer on the construction of the lines between Milford, Mich., and Northville and between Clare, Mich., and Averill, serving in this position until 1872 when he was promoted to general roadmaster. In 1891 he was promoted to superintendent of roadway and structures and in 1898 to engineer in charge of bridges and buildings. He was promoted to chief engineer of the Saginaw district on January 1, 1900, and late in the same year became assistant engineer, acting as engineer of water service from 1902 and 1905.

W. P. Kimble, assistant engineer assigned to special work on the Erie, with headquarters at Galion, Ohio, died in a hospital at Los Angeles, Cal., after an extended period of ill health. Mr. Kimble was born on April 6, 1858, at Paris, Ill., and graduated from the University of Illinois in 1879. He entered railway service in August of the same year in the engineering department of the Atchison, Topeka & Santa Fe at Las Vegas, N. M., serving in various capacities until January, 1881, when he became connected with the Mexican Central (now a part of the National Railways of Mexico), where he was locating engineer and division engineer on construction. In August, 1884, he left that road to engage in municipal and county engineering at Paris, Ill., returning to the Atchison, Topeka & Santa Fe as locating engineer on the line between Kansas City, Mo., and Chicago, later becoming division engineer on construction. When this line was put in operation he was made division roadmaster, and subsequently was promoted to general roadmaster. In March, 1894, he entered the service of the New York, Lake Erie & Western (now a part of the Erie) as division roadmaster and in 1897 was promoted to division engineer of the Cincinnati division, with headquarters at Galion, Ohio. He remained in that position until the latter part of 1917 when he was appointed assistant engineer and assigned to special work, which position he was holding at the time of his death.

Frederick Beaumont Sheldon, resident vice-president of the Ohio Central lines of the New York Central, with headquarters at Columbus, Ohio, died in that city on March 1, from heart disease. Mr. Sheldon was born on January 27, 1856, at Manchester, England, and entered railway service as a flagman on an engineering corps on the Arkansas Central on November 21, 1870, being promoted subsequently to draftsman. In May, 1872, he became a topographer on the Columbus & Toledo (now a part of the Hocking Valley) and was promoted successively to draftsman, assistant engineer and engineer on that and allied roads until October, 1888, when he was promoted to chief engineer of the Columbus, Hocking Valley & Toledo, serving in that capacity on that road and its successor, the Hocking Valley until November 1, 1910. He was also assistant to the president from January 1, 1900, to November 1, 1910, and assistant to the president of the Kanawha & Michigan (then partly controlled by the Hocking Valley) from September 1, 1901, to November 1, 1910. On the latter date he was made president of the Kanawha & Michigan, remaining in that position until January 1, 1915, when the road was leased by the Toledo & Ohio Central, at which time he was made vice-president of the T. & O. C., and of its subsidiaries, the Zanesville & Western and the Kanawha & Michigan. On January 1, 1922, when the Toledo & Ohio Central and its leased roads were leased to the New York Central and formed into the Ohio Central lines of that system he was made resident vice-president, which position he was holding at the time of his death.

Trade Publications

Welding and Cutting Apparatus—The Alexander Milburn Company has issued a 40-page catalog of its torches and other accessories for welding or cutting metals. Illustrations and brief descriptions are given of the various products and the catalog is of such size that it may be carried easily in a vest pocket.

Movable Bridge Accessories—The Norwood-Noonan Company, Chicago, has issued a 30-page catalog which presents in loose leaf form the special equipment manufactured and installed by this company for the control and operation of movable bridges. Pages are also devoted to descriptions and illustrations of electric crossing gates, bridge and pier lamps, warning signals, gasoline power unit, etc.

Turnouts and Crossings for Industrial Tracks.—The Weir-Kilby Corporation, Cincinnati, Ohio, has issued Catalog G of 104 pages, illustrating and describing the turnouts and crossings it manufactures for industrial tracks and other light railways. Sections and dimensions of rail weighing from 16 lb. to 40 lb. per yard are shown. The catalog also contains a number of tables and miscellaneous data to aid in designing and installing turnouts for this class of track in various gages.

Ballast Discers.—The Northwestern Motor Company, Eau Claire, Wisconsin, has issued an eight-page circular describing the Casey Jones ballast discer for destroying the weeds in the ballast shoulder and which also shapes the shoulder to the proper contour while it improves the drainage of the ballast. The circular is illustrated with photographs showing the discer in operation and with diagrams showing the method of application and other details.

Construction News

The Atchison, Topeka & Santa Fe has awarded a contract to the Cameron-Joyce Company, Keokuk, Ia., for the grading in connection with seven miles of realignment at Mulvane, Kan. A contract for the construction of second main track between Defiance, N. M., and Chambers, 40 miles, has been let to W. A. Bechtel, San Francisco, Cal.

The Baltimore & Ohio has awarded a contract let to the Vang Construction Company, of Cumberland, Md., for the grading and masonry on a new viaduct between Germantown and Barnesville, Md., seven and one-half miles. Another contract has been awarded to the Empire Construction Company, of Baltimore, Md., for additional track work on this project. This work is estimated at a cost of $1,650,000. A contract has been awarded to the Ogle Construction Co. of Chicago, Ill., for the construction of a 600-ton four-track electrically operated reinforced concrete coaling station at Ohio Junction, Ohio. This will include the construction of two three-track electrically operated cinder handling units and a 2500-ton reinforced concrete sand.

The Bangor & Aroostook will ask bids for the replacement of an old bridge with one of E-60 loading, and a span of 163 feet at Derby, Me., which is estimated to cost $36,000.

The Boston & Maine has awarded a contrart to Dwight P. Robinson & Co. for the erection of a new fruit exchange building at Boston, Mass., which it is estimated will cost $350,000.

The Birmingham Southern has applied to the Interstate Commerce Commission for authority to build an extension of 2.4 miles at Birmingham, Ala.

The Canadian National has awarded a contract for the construction of a 300-ton reinforced concrete coaling station at Belleville, Ont., to the Canadian Engineering & Contracting Company, Hamilton, Ont.

The Central of Georgia has awarded a contract to The U. G. I. Contracting Company, Healey Building, Atlanta, Ga., for the construction of a reinforced concrete and steel viaduct at Savannah, Ga., which it is estimated will cost about $480,000.

The Chesapeake & Ohio has awarded a contract to the Railroad Water & Coal Handling Company, Chicago, for the construction of water treating plants and pumping stations on the Chesapeake & Hocking at Ruble, Ohio, and Circleville.

The Chicago & North Western has awarded a contract to Roberts Brothers, Chicago, for the grading in connection with the construction of an extension from Nisland, S. D., 12 miles, and from Belle Fourche, S. D., 4 miles. These projects will involve the excavation of about 225,000 cu. yd. of earth. The company has reached an agreement with the city of Madison, Wis., for the construction of a viaduct over its tracks at Olin avenue, Madison. The expense of building this structure, about $200,000, will be borne by the railroad. The Chicago & North Western has awarded a contract to Anton J. Ebert, Argonne, Wis., for the construction of a combined freight and passenger station at Land O'Lakes, Wis.

The Chicago, Burlington & Quincy has awarded a contract for the construction of a one-story cement block pattern storage building, 80 ft. by 80 ft., at West Burlington, Ia., estimated to cost about $15,000, to the Zitterell Mills Company, Webster City, Ia.

The Chicago, Indianapolis & Louisville has awarded a contract for the construction of a brick and structural steel locomotive repair shop at Lafayette, Ind., to A. E. Kemmerer, Lafayette. The shop, which is expected to cost about $275,000, will contain fifteen locomotive pits, two 15-ton cranes, one 210-ton bridge crane and will have wood block floors.

The Chicago, Milwaukee & St. Paul has awarded a contract for the construction of a combined hotel and station at Gallatin Gateway, Mont., to cost about $200,000, to Tufel and Carlson, Seattle, Wash.

The Chicago, Rock Island & Pacific has awarded a contract to the Austin Bridge Company, Dallas, Tex., for the construction of a temporary pile trestle 2,000 ft. long across the Canadian river at a point six miles north of Fritch, Tex. This trestle will carry the new line now under construction north of Amarillo, Tex., over the Canadian river until a permanent steel bridge is constructed.

The Cleveland, Cincinnati, Chicago & St. Louis has let a contract to the Ogle Construction Company for the construction of a 500-ton four-track electrically operated reinforced concrete coaling station at Riverside, Ohio.

The Delaware, Lackawanna & Western has awarded a contract to the Arthur McMullen Company, New York, for the construction of third and fourth main tracks in the vicinity of Boonton, N. J., at a cost of about $300,000.

The Detroit & Ironton has applied to the Interstate Commerce Commission for a certificate authorizing the construction of a branch line extension as a relocation of the line of the Toledo-Detroit between Petersburg Junction, Mich., and Toledo, Ohio.

The Elgin, Joliet & Eastern has awarded a contract for the construction of a one-story brick and concrete dormitory at South Chicago, Ill., to G. A. Johnson & Sons, Chicago, at a cost of about $25,000.

The Erie has let a contract to Charles Shutrump & Sons Co., for the construction of a five-story freight and storage terminal, 422 ft. by 87 ft., at Youngstown, Ohio. The building will be of reinforced concrete.

The Fordyce & Princeton has been authorized to build a branch approximately five miles long in Dallas County, Ark.

The Gulf, Colorado & Santa Fe has prepared plans for the construction of a 115-ft. turntable at Brownwood, Tex. Improvements at this point also include the enlargement of the freight yards to provide for the handling of 750 cars. Authorization has been given for the construction of a second main track between Panhandle, Tex., and Pampa, 27 miles.

The Illinois Central has awarded a contract to the Ellington Miller Construction Company for rebuilding a brick, reinforced concrete and limestone passenger station at Jackson, Miss., including the remodeling of the express and baggage depot, a new passenger depot, and new waiting rooms. The entire cost will be approximately $400,000.

The Kansas City, Mexico & Orient has awarded a contract to Terrazas & Matquia, Chihuahua City, Mex., for the construction of an extension from Las Norias, Chih., northward to the crossing of the Rio Grande river, near Presidio del Norte, Chih., 49 miles. Surveys have been completed for the construction of the line between Presidio del Norte and Alpine, Tex., about 100 miles.

The Louisiana Railway & Navigation Company of Texas, through R. R. Farmer, vice-president, has announced plans for the extension of its line from McKinney, Tex., west to some point on the line of the St. Louis-San Francisco—either Celina, Tex., Frisco or Prosper, about 10 miles. Further plans call for extension beyond the St. L.-S. F. to Decatur, Tex., to a connection with the Ft. Worth & Denver City, about 45 miles. It is also planned to rebuild the line between Greenville, Tex., and McKinney, 32 miles.

The Louisville & Nashville has awarded a contract to McClintic-Marshall Company, of Pittsburgh, Pa., for bridge work on the Tensas River bridge. Four thousand tons of structural steel will be involved in this work. A contract has been awarded to the Missouri Valley Bridge & Iron Company, Leavenworth, Kan., for the construction of a bridge over the Mobile river near Mobile, Ala. The bridge, whose superstructure will be fabricated by the Ameican Bridge Company, Chicago, will consist of three fixed through spans, one through plate girder span and one 330-ft. draw span. The construction of an office building at Latonia, Ky., and expansion of its yards at De Coursey, Ky., and Spring Lake are contemplated.

The Maine Central has awarded a contract to Fairbanks,

Morse & Co., of Chicago, Ill., for the construction of a mechanical coal handling plant at Calais, Maine. Another contract has been let to the Chicago Bridge & Iron Works for the construction of a 50,000-gal. capacity water tank at Calais, Maine. The above projects are estimated to cost about $40,000.

The Michigan Central has awarded a contract for a 50-ft. by 600-ft. two-story brick and concrete fruit auction building at Detroit, Mich., estimated to cost $300,000, to the Ellington Miller Construction Company.

The Minneapolis, St. Paul & Sault Ste. Marie budget for 1927 provides for the enlargement of Schiller yard at Chicago at a cost of about $525,000, the expenditure of $100,000 for terminal improvement at Chicago and an expenditure of a like amount for reduction of grades on the Chicago division.

The Missouri Pacific has prepared plans for the construction of 10 miles of second main track between Curtis, Ark., and Bierne, estimated to cost $863,000.

The Missouri-Kansas-Texas has awarded a contract for the replacement of the superstructures of steel bridges at Boughner, Mo., and Rocheport, and at Crowder, Okla., and Elk City, with through riveted truss spans designed for Cooper's E-60 loading, to the Mt. Vernon Bridge Company, Mt. Vernon, Ohio, at a cost of about $80,000. A contract for the construction of a reinforced concrete underpass at Tushka, Okla., has been let to T. H. Johnson, Sedalia, Mo.

The New York Central has contracted with the McClintic-Marshall Company for the fabrication and erection of the steel work required for a new office building over Park avenue, between Forty-fifth and Forty-sixth streets, New York City, involving the purchase of approximately 27,000 tons of steel. The contract provides for the steel work to be erected 60 ft. above the street level by October 1, 1927, and to be completely erected by February 1, 1928. A contract has also been awarded to the Jobson-Gifford Company, of New York City, for filling of temporary tracks north of Dyckman street at New York City.

The New York, New Haven & Hartford has awarded a contract to the Lathrop & Shea Co., New Haven, Conn., for the construction of a freight yard, and freight house and driveway at Harrison, N. Y., at an estimated cost of $70,000.

The Norfolk & Western has awarded a contract to J. P. Pettyjohn & Co., of Lynchburg, Va., for an extension to Pier "S," for constructing a warehouse for perishables, and an office building at Lambert Point, Va. It is estimated that this work will cost approximately $50,000.

The Northern Pacific plans the reconstruction of the bridge over the Rattlesnake river near Missoula, Mont., at an approximate cost of $36,000.

The Oregon-Washington Railroad & Navigation Company has included in its budget for 1927 the proposed expenditure of $85,000 for the construction of a mill for boring, adzing, incising and stamping new ties at the tie treating plant at The Dalles, Ore. Landing facilities will be constructed at Astoria, Ore., and Megler, Wash., to accommodate the operation of a ferry-boat crossing the Columbia river between these points. Approximately $275,000 will be expended for the construction of miscellaneous roadway buildings.

The Pennsylvania has closed bids for the construction of a two-story trainmen's dormitory at Hawthorne yard, Indianapolis, Ind. The building, which will have outside dimensions of 100 ft. by 100 ft., is expected to cost about $40,000. A contract has been awarded to Sinclair & Grigg of Philadelphia, Pa., for the construction of buildings, platforms and shelters at South Philadelphia, and a perishable products terminal at Baudales street and Oregon avenue, Philadelphia, which, it is estimated, will cost about $500,000.

The Port Angeles Western has applied to the Interstate Commerce Commission for a certificate authorizing an extension of 20 miles from Tyee to Forks, Wash.

The Quanah, Acme & Pacific will close bids on April 7 for the construction of an extension from McBain, Tex., to Floydada, 27 miles.

The St. Louis-San Francisco has awarded contracts to Reed & Lowe, Birmingham, Ala., for the grading in connection with the construction of mechanical department facilities at Yale, Tenn., and to the Layne Central Company, Memphis, Tenn., for the drilling of two deep wells of a capacity of 1,000 gal. per min. The latter work will cost about $20,000. A contract has been awarded to the Virginia Bridge & Iron Company of Roanoke, Va., for the construction of various bridges at Pensacola, Fla., at an estimated cost of $37,000.

The San Antonio & Northwestern has filed a charter in Texas for the construction of a line between San Antonio, Tex., and San Angelo, 234 miles, and announced that it will apply to the Interstate Commerce Commission for authority to proceed with construction.

The San Benito & Rio Grande Valley has applied to the Interstate Commerce Commission for authority to build an extension from a point near La Paloma, Tex., in a general southeasterly direction, approximately 15 miles.

The Seaboard-All Florida has been granted an extension to June 1 by the Interstate Commerce Commission for the completion of the lines from Palm Beach to Florida City and from Fort Myers toward La Belle, Fla., under the certificates issued by the commission.

The Southern has closed bids for the construction of reinforced concrete coaling stations as follows: Monroe, Va., 1,000 tons capacity; Columbia, S. C., 1,000 tons capacity; Bulls Gap, Tenn., 375 tons and 225 tons capacity; Atlanta Junction, Ga., 800 tons capacity; Coster, Tenn., 500 tons capacity; Sheffield, Ala., 500 tons capacity, for the construction of concrete and steel coaling stations of 200 tons and 300 tons capacity at Anniston, Ala., and for the construction of steel coaling stations at Lawrenceburg, Va., 300 tons capacity; Winston-Salem, N. C., 300 tons; and Jacksonville, Fla., 300 tons.

The Southern Pacific plans the construction of a locomotive repair shop at Eugene, Ore., at a cost of about $220,000. Additional trackage, live stock pens, stores buildings and incidental structures at the same point will involve an estimated expenditure of $250,000.

The Tennessee & Northern has been authorized to construct an extension of its railroad from Summit in a general southerly direction to the port of Mobile, a distance of approximately 30 miles, in Washington and Mobile counties, Alabama. The cost of constructing the extension on the new route is estimated at $813,352, not including interest during construction.

The Virginian has awarded a contract to Morris, Gray and Hunter of Roanoke, Va., for the construction of a sub-grade for a passing track extension on the Norfolk division, which it is estimated will cost about $35,000.

The Wabash plans the construction of a 10-stall roundhouse, a 100-ft. turntable, a water tank and a trainmen's service building at Ft. Wayne, Ind., at a cost of about $200,000.

The Western Pacific has applied to the Interstate Commerce Commission for a certificate authorizing the construction of a branch line from Kingdon station to Terminus, San Joaquin county, Calif., 7.5 miles.

Fifty Years of Service.—The Western Wheeled Scraper Company, Aurora, Ill., has issued a 168-page book commemorating the fiftieth anniversaryof its establishment, and containing a history of its growth which has been co-existent with the development of labor saving machinery as applied to earthwork. Beginning with the simpler forms of scrapers the company has steadily increased its products to include elevating graders, dump wagons and dump cars in various sizes, not only for grading, but also for the transportation and disposal of waste products such as cinders and other refuse. The book is of attractive typographical appearance and is copiously illustrated showing the various units of equipment in detail and also in operation.

Supply Trade News

General

The offices of the **National Railway Appliances Association** and of **C. W. Kelly,** secretary-treasurer, have been moved to the Oliver building, 1014 South Michigan avenue, Chicago.

The Parsons Company, Newton, Iowa, has made arrangements whereby the **Fairmont Motors, Inc.,** will distribute the Parsons crane through the latter's sales organization. **William S. Miller** will continue as manager of the railroad department of the Parsons Company to co-operate with the Fairmont sales forces in distributing the Parsons cranes and other machines which are being developed by the Parsons Company.

The Ramapo Ajax Corporation, Hillburn, N. Y., has established the **Racor Pacific Frog & Switch Works** at 3355 East Slauson avenue, Los Angeles, where it will manufacture the same products as the other plants of the company. **H. W. Renick,** Pacific coast representative, has been elected vice-president in charge of the new plant, and **W. J. Janicki,** formerly assistant chief engineer of the Chicago plant, has been appointed district engineer and superintendent, with headquarters at Los Angeles.

Personal

George F. Konold, Jr., secretary of the Warren Tool & Forge Company, Warren, Ohio, has been elected president to succeed James D. Robertson, deceased.

William T. Kilborn, who has been assistant sales manager of the Graham Bolt & Nut Company, Pittsburgh, Pa., has been promoted to general sales manager. Mr. Kilborn graduated from Andover Academy and served overseas as a first lieutenant in the field artillery during the World War. On his return to this country, and after the termination of his military service, he entered business, becoming associated with Charles J. Graham in the sales department of the Liberty Steel Products Company and later was connected with the American Railway Appliances Company. Subsequently he was appointed assistant sales manager of the Graham Bolt & Nut Company, Pittsburgh, in which position he was serving at the time of his recent promotion to general sales manager.

William T. Kilborn

R. C. Violett, formerly division engineer on the Denver & Rio Grande Western, with headquarters at Pueblo, Colo., has been appointed Denver representative of the American Fork & Hoe Company, with headquarters at 520 East Fourteenth avenue, Denver, Colo.

W. W. Fitzpatrick, formerly general sales manager of the Rawls Manufacturing Company, Chicago, has become associated with the Nordberg Manufacturing Company, Milwaukee, Wis., and will devote his entire time to the sale of the Nordberg track machine.

Clyde E. Beckett and **George S. Holland** have been added to the engineering staff of the concrete department of the **Celite Products Company** at Chicago. Mr. Beckett was formerly with the L. E. Myers Company, Chicago, and Mr. Holland was formerly in the engineering department of the city of Des Moines, Iowa, and later with the Harrison Construction Company of that city.

O. J. Nestlage, representative of the Sullivan Machinery Company, Chicago, with headquarters at Joplin, Mo., has been promoted to local manager, with headquarters at Mexico City, Mex., succeeding **A. W. Oakes,** who has been transferred to the United States. **C. W. Miller** has been appointed special representative at Havana, Cuba.

F. R. McMillan, manager of the structural and technical bureau of the Portland Cement Association, has been promoted to director of research in charge of all investigations in cement and concrete, succeeding **Duff A. Abrams,** who has resigned to engage in private practice. Mr. McMillan graduated from the University of Minnesota in 1905 and was a member of the faculty of that institution for nine years, in charge of concrete design. He has been connected with the association since April, 1924, and prior to that time was in consulting practice in Minneapolis, Minn., on the staff of the Frederick Construction Company, New York, and was in charge of concrete ship design for the government during the war. Mr. Abrams was graduated from the University of Illinois in 1905 and became connected with the engineering experiment station of that university. In 1912, he became professor in charge of structural materials research of Lewis Institute, Chicago, which was taken over by the Portland Cement Association in 1916.

Trade Publications

Railroad Platform Derricks—The American Hoist & Derrick Company, St. Paul, Minn., has issued a four-page circular describing and illustrating its stiff-leg platform derricks, which are furnished in capacities ranging from 5 to 20 tons, together with the "American" electric crab and slewing attachment for operating these derricks.

Genuine Wrought Iron Pipe.—In bulletin No. 2 recently issued by the Reading Iron Company, Reading, Pa., are contained a number of interesting service records of Reading genuine wrought iron pipe. The bulletin also contains two interesting articles on ways to determine genuine wrought iron pipe, its advantages and manufacture.

The Kyrock Book—The Kentucky Rock Asphalt Company, Louisville, Ky., has issued a 32-page booklet describing the natural asphaltic rock from which Kyrock is prepared and setting forth its advantages as a paving for driveways on roads and bridges. The booklet is copiously illustrated with views showing completed installations as well as the methods of application.

Stainless Steel and Iron.—An 18 page bulletin issued by the Bethlehem Steel Company, Bethlehem, Pa., describes Bethlehem Stainless Steel and Bethlehem Stainless Iron and gives working instructions for forging and annealing both of these metals. A list of the principal applications is presented as is also a list of the corrosive agents which will not affect these metals.

Railway Water Service.—The Pittsburgh-Des Moines Steel Company, Pittsburgh, Pa., has issued a 24-page booklet illustrating and describing its railway water service equipment for the storage and treatment of water. The book contains detailed data relative to its standard and special railway type tanks, its standpipe and its settling tank for water treating service, as well as its oil service tank for oil burning roads. The catalog also contains information concerning the roadside units for the storage of gasoline and other fuel oils.

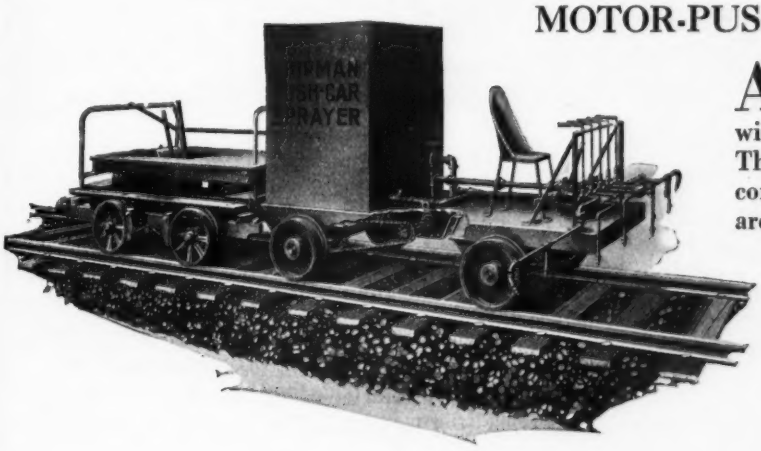
The Cal Book.—In a booklet of 32 pages the North American Cement Corporation, Hagerstown, Md., presents a treatise on Cal (oxychloride of calcium) as an admixture to Portland cement concrete, for which purpose it is used as a means of accelerating the setting of concrete, increasing the compressive strength and as protection to concrete against freezing. Particular attention is given to the effect of this material in securing early strength and several tables and charts are presented which show the results of tests made to illustrate these properties. A section of the booklet is also devoted to instructions for the use of Cal in concrete. A number of photographs show structures in which Cal was used.

Recent Developments

Save Locomotive Cost In Chemical Weed Killing

FOR railroads to apply weed killer with section forces, without the cost of expert supervision, locomotive or train crews, Chipman engineers have developed the automatic motor car trailer and the hand spray.

MOTOR-PUSH CAR SPRAYER



A COMPLETE weed killer spray apparatus for use with a heavy duty motor car. The spray head is sectionally controlled according to standard design.

The pump is geared to the axle and coordinates chemical discharge with car speed.

Operates 5 to 10 miles per hr.
Capacity 2 to 5 miles per load
Tank 600 gallons.

Shipped complete ready for use. Any two men can operate it.

Can be used on stretches up to 100 miles, terminal yards or cleaning up ballast edges to grass line on track otherwise free from weeds.

CHIPMAN PORTABLE SKID SPRAY

A WEED killer spray apparatus which will cover 5,000 to 10,000 square feet of vegetated track each half hour. Useful in storage yards, terminal tracks or for cleaning up patches of weeds in line tracks. Two men can operate and the apparatus is adjusted for proper distribution in the hands of a novice.

Write for descriptive matter and prices

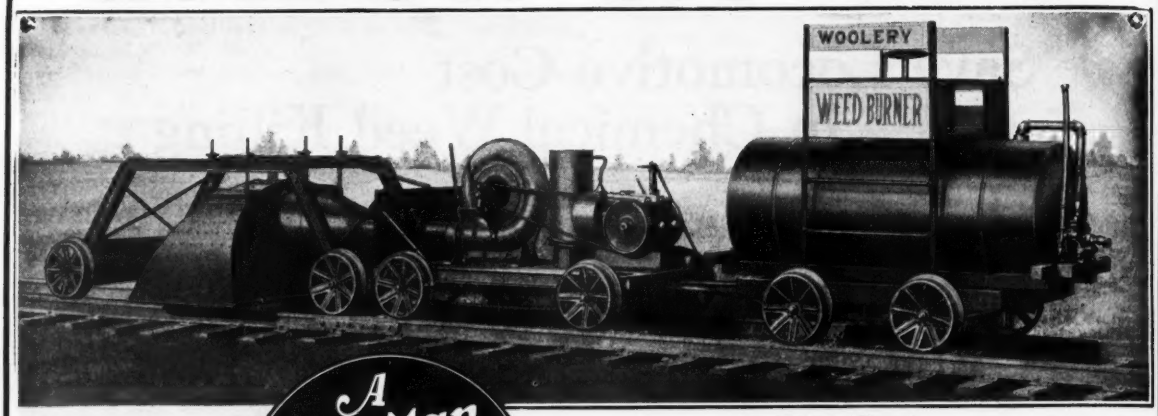
CHIPMAN CHEMICAL ENGINEERING CO., INC.

BOUND BROOK, NEW JERSEY

Factories: **Bound Brook, N. J. Clearing, Ill. Palo Alto, Cal. Houston, Tex.**

ATLAS SERVICE

LABOR SAVERS



Patent Allowed

A Two-Man Outfit of Guaranteed Efficiency
Average cost on first heavy burning less than
$3.00 per mile

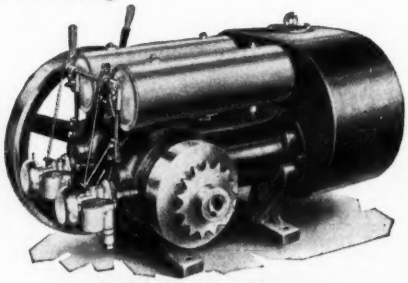
The greatest losses in the United States every year are caused by fire. Likewise the greatest saving in track maintenance costs on American Railroads the past three years have been due to fires—i.e. flames produced and controlled by Woolery Weed Burners. Many thousand miles of track cleaned by this equipment at the lowest cost ever achieved for this work prove that flames do pay.

Clean track with Flames instead of hand labor and save 30 to 60% of present costs.

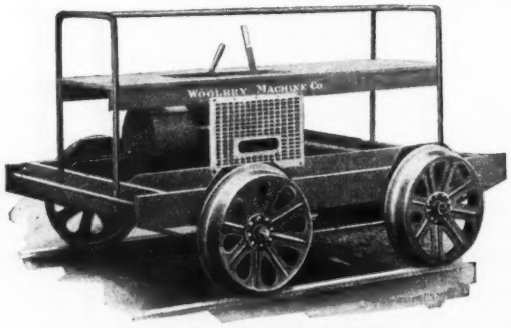
Investigate **now** for this year's savings.

Model "CC" Engine

A Midget for Size but a Giant for Strength. The superiority of this engine for heavy work requiring the utmost in dependability has been thoroughly demonstrated. It is the power plant for our heavy-duty Motor Cars and Railway Weed Burners, both of which have performance records second to none.



Model "CC" Engine



Railway Motor Cars

Furnished either with Direct Belt Drive or 2-Speed Bevel Gear Transmission

Rail Layer Attachments
Tie Scoring Machines
Power Bolt Tighteners

WOOLERY MACHINE CO. Write for further information **Minneapolis, Minn.**

Speed Up Your Maintenance Painting and Reduce Costs At the Same Time

THIS WAY

Illustration at the right shows painters painting B. & O. Freight Station with one of the 13 Matthews Mechanical Painting Equipments used by this railroad for maintenance painting.

Every large railroad has found a problem in keeping up with its maintenance painting. Not only that of keeping within the painting appropriation, but also getting the painting done on time without the necessity of employing too great a force of painters during certain seasons. This is no longer a problem to the B. & O. Railroad. After giving several mechanical painting equipments many practical tests over a period of many months, the B. & O. equipped their division points with 13 Figure 105 Matthews Mechanical Painting Equipments. They are now doing their maintenance painting in about one-fifth the time it took them formerly and at a fraction of the cost. Other railroads are using Matthews Equipments with great success. The Figure 105 Matthews Mechanical Painting Equipment is ideally designed for this type of work. Investigate it.

Fig. 105. Complete two-unit with heavy duty equipment. Air capacity sufficient to operate three units or one rotary wire brush.

Get This Booklet

"Mechanical Painting For Maintenance" is a 12 page booklet that will answer many of the questions you will want to ask about your painting problems. Tells about mechanical painting in general. Gives comparative costs on brick, corrugated iron, stucco, weatherboard, shingle roofs, tanks and all kinds of interior surfaces. Gives full information regarding the different kinds of materials handled and how to select them. Shows photographs of different equipments and close ups of various units in their make up. Gives extracts from 14 letters received from prominent manufacturers regarding their experiences. Has a page of questions and answers. Tells about instruction to your men and service you can expect. Send for this booklet to-day.

W. N. MATTHEWS CORPORATION
3770 Forest Park Blvd. St. Louis, U. S. A.

MATTHEWS
MECHANICAL PAINTING
EQUIPMENT

27MP

Economical Coal Handlers

This Company Owns 18

Sixteen years ago a central station in one of the big Great Lakes cities made an investigation of different coal handling methods before they bought their first Brownhoist—Crane No. 3596. Today they operate 18 Brownhoists, all 8-wheel steam cranes.

These cranes have handled millions of tons of coal, besides excavating for new plants, driving and pulling piles, handling heavy loads by hook block and a great amount of switching.

Ever since 1910 this user has proved the rugged strength, long life and economy of Brownhoists. They know cranes because they have a much better opportunity to study and test them than most companies.

Crane No. 3596 is shown working at the storage pile. Above is the modern Brownhoist 20-ton crane with 54-cu. ft. Link-type Coal Bucket.

And they rely on their Brownhoists because they have made good.

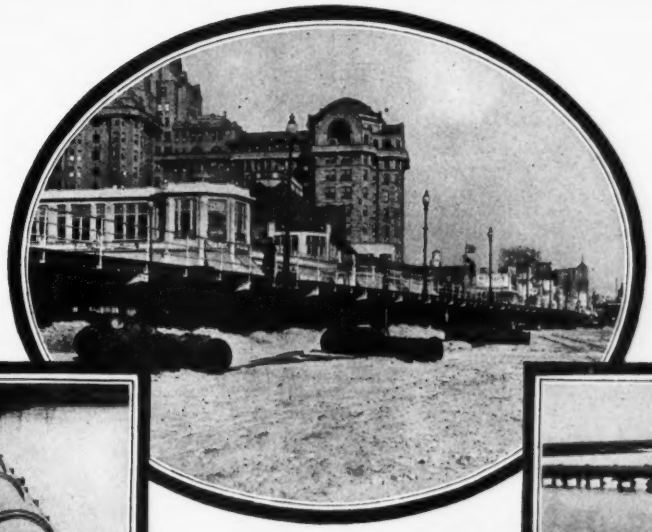
Why don't you, too, make an investigation of your handling costs, remembering that this big user has put his stamp of approval on Brownhoists and that there is a Brownhoist to suit every need? We shall be glad to cooperate with you.

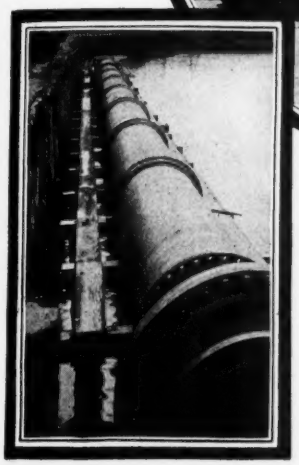
The Brown Hoisting Machinery Co., *Cleveland, Ohio*

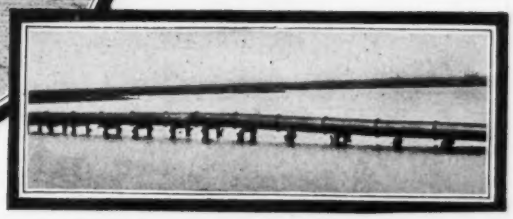
Branch Offices: New York, Chicago, Pittsburgh, San Francisco, New Orleans.

BROWNHOIST

GOOD MATERIAL HANDLING MACHINERY







Atlantic City uses Cast Iron Pipe

in its water and gas supply lines and sewage disposal system

THESE illustrations demonstrate how well Cast Iron Pipe solves the problem of unusual installations.

The different lines run under sand, over salt marshes, on pontoons and across bridges.

Our engineering department will be glad to co-operate with you in the solution of any installation problem.

Write for U. S. Cast Iron Pipe handbook, which contains all necessary data on specifications.

United States Cast Iron Pipe & Foundry Co.
Makers of
deLavaud
Centrifugal
Cast Iron Pipe
PATENTED

United States Cast Iron Pipe *and* Foundry Company

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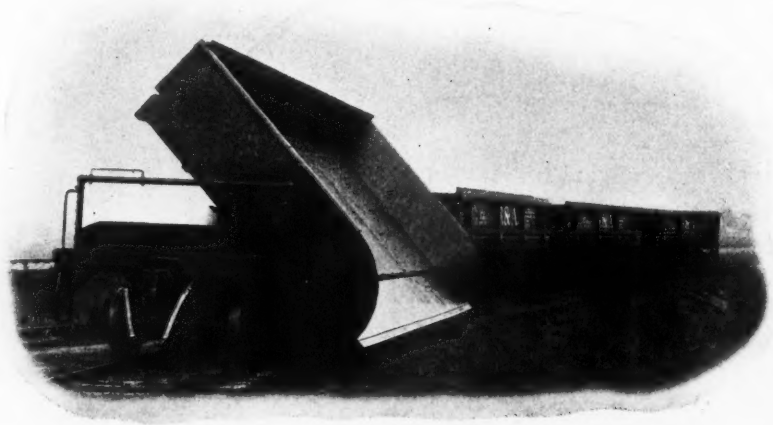


5 Features of the DIFFERENTIAL

Double Fulcrum

AIR DUMP CAR

Any one sufficient economic reason for the selection of
DIFFERENTIAL CARS

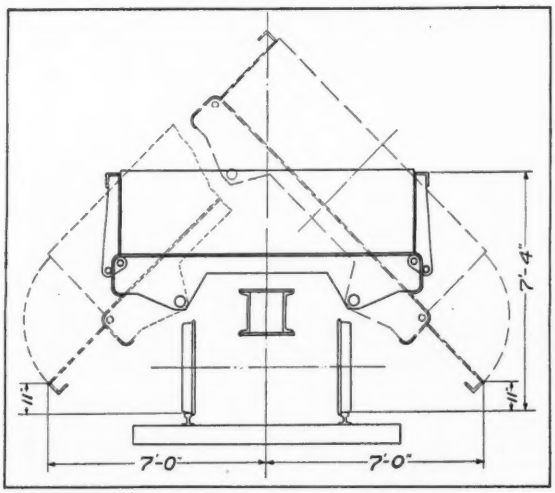
SAFETY—Cannot dump accidentally.
LOW HEIGHT—Easy to load; see diagram below.
DUMPS FAR FROM TRACK—Keeps the ballast clean.
SIMPLICITY—No locking mechanism.
RUGGEDNESS and LONG LIFE—Superior construction and design.

Complete description upon request.

THE DIFFERENTIAL STEEL CAR CO.

Findlay, Ohio

The advantages mentioned above can be secured only with the Double Fulcrum Principle.



This car, the most important development in dump car design for many years, was conceived and developed by The Differential Steel Car Co.

Patented

50,000 Gallons per Hour

THIS pumping station and treating plant furnish satisfactory water for the new Florida East Coast Terminals at Bowden, Florida.

The pumping station at the rear left houses a motor driven centrifugal pump (with auxiliary gas engine) capable of handling 1,000 gallons per minute from the two deep wells through the treating plant and into the tank.

In addition to settling time, the tank is designed to give 20,000 gallons of clear water storage at an elevation suitable for delivery to the water columns throughout the yards.

The entire station (except the deep wells) was laid out, designed and built by the Pittsburgh-Des Moines Steel Company.

We offer you a complete general contracting service, backed by thirty years of experience, on any work involving water supply, treating or storage. Submit your plans for tanks, treating plants or pumping stations to the nearest Pittsburgh-Des Moines office for estimates. Or ask an engineer to call and discuss your work with you.

Write for our new Railway Catalog No. 72

PITTSBURGH TANKS DES MOINES

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Des Moines
New York
Atlanta
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Pittsburgh-Des Moines Steel Company

674 Professional Bldg., Pittsburgh, Pa **976 Tuttle St., Des Moines, Ia.**

PITTSBURGH DES MOINES

This Job Will Last—

They Are Using Toncan Iron

TONCAN COPPER Mo-lyb-den-um IRON

HERE a line of Toncan Iron sub-drains is being installed to keep a sag in the track clear when heavy rains soak the grade.

They are expected to function for years, withstanding the corrosion of soil and water.

Replacement on a job of this kind is too expensive a matter to take any chances with material, so Toncan Iron is specified.

Toncan Iron has all the corrosion resistance of pure iron plus the additional protection of copper and molybdenum. These two elements give still further resistance to weathering and corrosion.

Where permanence is needed, as in corrugated culverts, Toncan Iron affords the greatest assurance of long life.

Following are the makers of Toncan Culverts. Write the nearest one:

The Berger Manufacturing Co. Roanoke, Virginia
Tri-State Culvert Mfg. Co. Memphis, Tenn.
The Canton Culvert & Silo Co. Canton, Ohio
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The Berger Manufacturing Co. Minneapolis, Minn.
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CENTRAL ALLOY STEEL CORPORATION, *Massillon*, OHIO
Makers of Agathon Alloy Steels

Cleveland Detroit Chicago New York St. Louis
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TONCAN IRON

MEETING THE DEMANDS

EAST ST. LOUIS, ILLINOIS—1879
HILLBURN, NEW YORK—1881
CHICAGO, ILLINOIS—1883
NIAGARA FALLS, NEW YORK—1903
NIAGARA FALLS, CANADA—1906
PUEBLO, COLORADO—1914
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AND NOW

LOS ANGELES

In our long years of experience (since 1879) it has been our aim always to anticipate every demand railroad development has required in refinement of design and accuracy of construction. RACOR products have a reputation, from Coast to Coast, for quality, performance and tested values that to many railroads mean safety, longer life and lowerd maintenance cost.

The locations of the eight works of the Ramapo Ajax Corporation have been selected to supply local service at most of the larger railroad centers. This chain of works is the greatest organization in the world devoted exclusively to the production of switches, frogs, crossings, switch stands, etc., for steam railroads.

RACOR

PRODUCTS

HEAVY DUTY HEAT TREATED GUARD RAIL CLAMPS
DROP FORGED RAIL BRACES
ADJUSTABLE RAIL BRACES
EUREKA ADJUSTABLE CLIPS
MANGANESE REINFORCED SWITCH POINTS
RAMAPO AUTOMATIC SAFETY SWITCH STANDS
AJAX MANGANESE ONE-PIECE GUARD RAILS
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SWITCHES – FROGS
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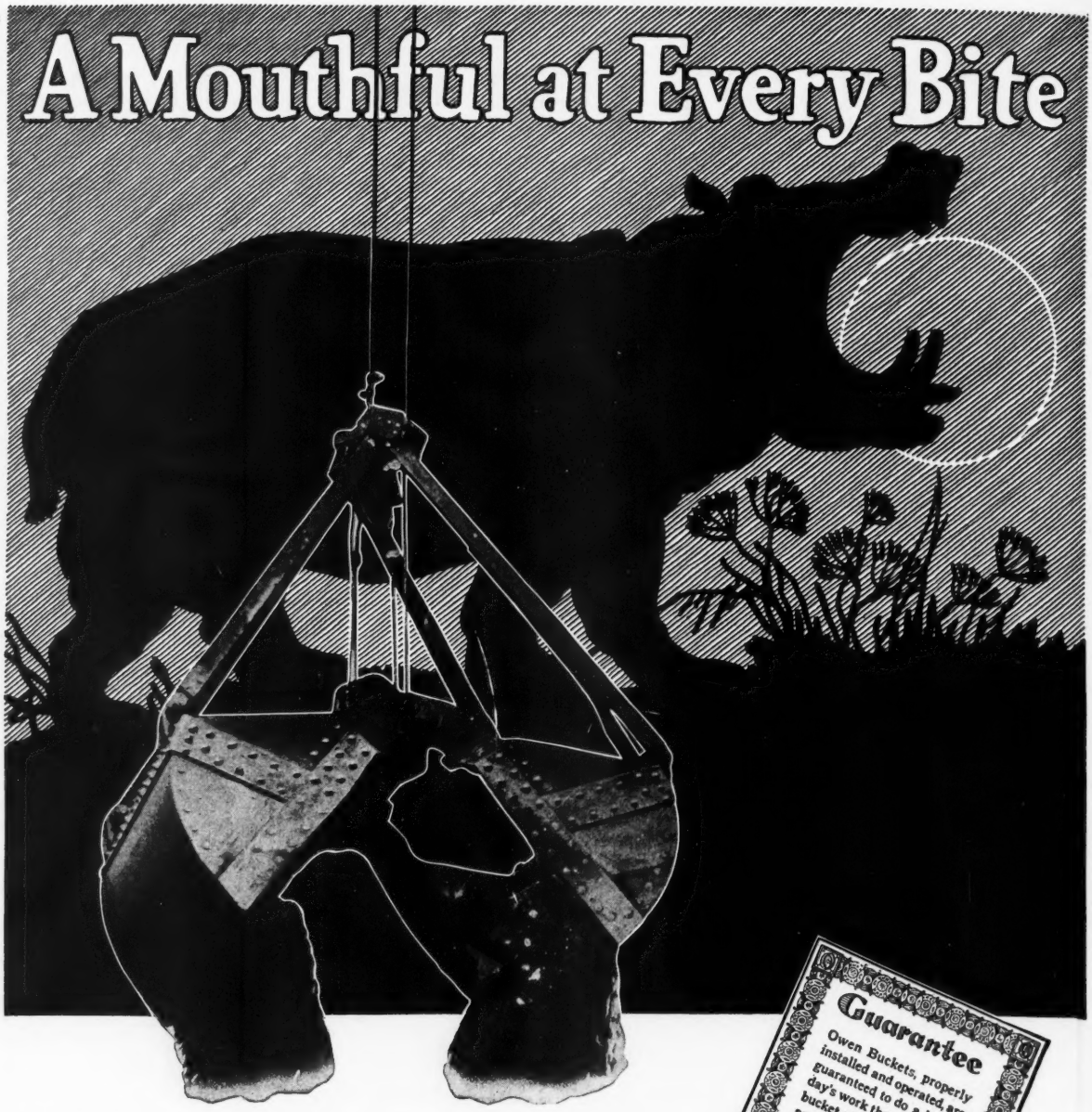
RAMAPO AJAX CORPORATION

A Mouthful at Every Bite



AN enormous mouth enables the Hippo to gather in a vast amount of food at every gulp. Similarly the wide spreading jaws of the Type "S" Owen Cleanup Bucket cover a huge amount of material—and they get it all when they close. This ability to cover a larger area and clean up more material saves many trips over the ordinary bucket.

While adapted particularly to barge unloading, this Owen will do more in less time on all kinds of cleanup work. It overloads when the material is deep and gets "A Mouthful At Every Bite" if there is enough material under it.

Write for details. You'll be surprised at the low prices.

Guarantee
Owen Buckets, properly installed and operated, are guaranteed to do a bigger day's work than any other bucket of the same weight and capacity—
—or—
Write your own guarantee!
THE OWEN BUCKET CO.

The above guarantee stands alone—in a class by itself. So does the Owen Bucket.

THE OWEN BUCKET CO.
6019 BREAKWATER AVENUE · CLEVELAND, OHIO

OWEN CLAMSHELL BUCKETS BIGGER DAYS WORK

Owen Buckets

Heavy Duty Railway Motor Car

Casey Jones 551

REG U.S. PAT OFF

Standard Ford Motor-Gear Transmission

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FOREIGN
KOPPEL INDUST. CAR & EQUIP. CO.
Koppel, Pa., Exclusive Export Agents

FOR EXTRA GANGS—BRIDGE CREWS—HUMP AND SIGNAL SERVICE—OPERATING WEED MOWERS—DISCING MACHINES AND ALL HEAVY DUTY SERVICE. CAPABLE OF MOVING 150 MEN WITH TRAILERS.

THE RIGHT CAR FOR EVERY CLASS OF SERVICE			
Class A	For Heavy Duty	Casey Jones 551	4 to 150 Men—Trailers
Class B	For Standard Section	Casey Jones 521	2 to 30 Men—Trailers
Class C	For Light Inspection	Casey Jones 531	1 to 4 Men

NORTHWESTERN MOTOR CO.

MANUFACTURERS

FACTORY AND GENERAL OFFICE—EAU CLAIRE, WIS.

ONE PRINCIPLE FOR TWENTY YEARS

PITTSBURGH

30 cu. yd. Extension Side Dump Cars transporting dirt and boulders for filling bridge approaches on the Santa Fe.

STABLE ON TRACKS

TWENTY cars dumping from a trestle on the Santa Fe, demonstrates the stability of Extension Side Dump Cars on the tracks. This stability is due to the Balanced Principle of the cars which reduces the shock in dumping, to a minimum and also admits of a high live load to dead load ratio.

Extension Side Dump Cars are furnished in capacities from 21 to 50 yards, level full. From 35 to 50 yards they are equipped with Pneumatic Reversal for two-way dumping. Below 35 yards they may be so equipped on specification.

CLARK CAR COMPANY

BALANCED DOOR DUMP CARS

PITTSBURGH, PA.

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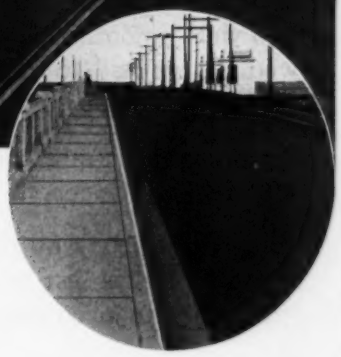
CLARK CARS

EXTENSION SIDE DUMP



L. & N. R. R. Memphis, Tenn.

Kyrock-Surface on heavy duty grade-crossing. Four busy tracks and a busy street, subjected to heavy loads and considerable steel tired traffic. Maintenance nil. Inset shows "Kyrock" surface on Biscayne Bay Causeway. Carried traffic estimated at 30,000 vehicles daily for seven years under Florida Sunshine—Not a crack or roll in it today. Kyrock resists vibration.

Kyrock cuts costs at crossings

Kyrock at grade-crossings offers you simpler construction, longer life, easier maintenance and less of it. On bridge floors it reduces vibration to its lowest terms. "Kyrock" is laid *cold*. Stored in the open without damage. It retains its life, cut it for track repair and the refill bonds under traffic. Perfect waterproofing and non-conductor. Requires no heating or mixing. Any section crew can lay "Kyrock" successfully without special equipment. Converts cracked concrete, worn brick, block and macadam platforms, runways, shop floors into smooth, resilient, long-life pavements. *Investigate "Kyrock."*

Make This Test—

"Kyrock" your most troublesome grade-crossing or platform, observe results and you will soon adopt it for the division. Write today for your copy of "Kyrock for Railway Construction and Maintenance."

KENTUCKY ROCK ASPHALT CO., Incorporated, LOUISVILLE, KY.

Kyrock

The **Perfect Pavement**

KENTUCKY ROCK Kyrock ASPHALT

"Would have had to double up section gangs"

"MY section gangs are very light," says an Illinois roadmaster. "With a Bloxham track liner I lined one 4-degree curve with three men; only having five men on this section. The other two were smoothing. Otherwise I would have had to double up section gangs to do this lining."

Bloxham liners are the choice of the man on the job.

Not only do they do the job with less men and in less time but they give relief to tired muscles.

They operate with a pull—not a lift.

Let us make a demonstration.

Chicago Steel Foundry Co.

KEDZIE AVE. AT 37TH ST.
CHICAGO, ILLINOIS

W. R. McDonough & Co., National Bldg., Cleveland, Ohio
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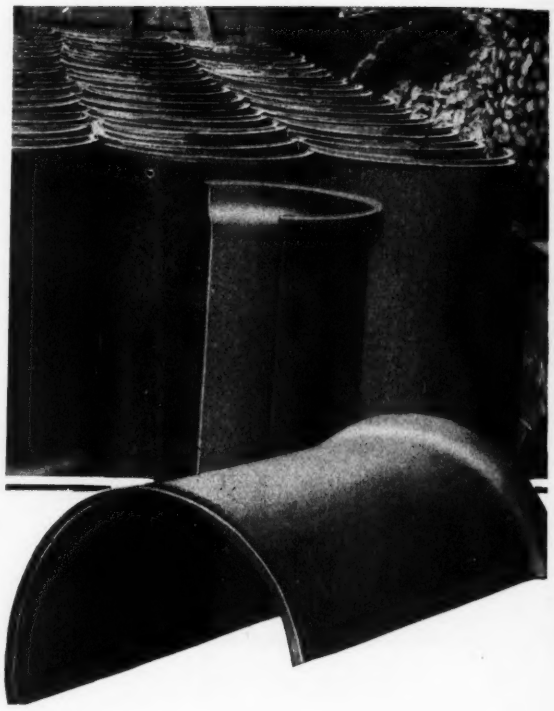
W. R. Payton, Railway Exchange Bldg., St. Louis, Missouri.
John A. Findlay, 105 Victoria St., Toronto, Ont.

BLOXHAM
Track Liners

RE&M4-Gray



Split Pipe

Hub & Spigot

instead of
wooden box drains

for railway tunnels

NOW you can make another sharp reduction in tunnel maintenance!

You can use Cast Iron Hub and Spigot pipe—instead of those old wooden box drains that are in constant need of reflooring and replacement.

A new process for getting perfect sections of SPLIT (Hub and Spigot) pipe has been worked out. And the first big installation—for a 1¼ mile tunnel on the lines of the C. & O. Ry.—has been completed.

SPLIT sections of permanent CAST IRON pipe! That means you can complete a tunnel drainage job and consider it finished—for all time.

Get all the facts. They offer a new solution to the drainage problems that confront you this year.

AMERICAN CASTING COMPANY
Culvert Pipe Headquarters *Birmingham, Ala.*

Safety
Economy
Long Life
PLUS

Service that only PAGE can render~

The New York Central is representative of many leading railroads providing safety along the right of way through Page Chain Link Fence. In districts where trespassing leads to costly damage suits, unclimbable Page Fence saves lives and maintains privacy along the property line.

Page engineers have studied railroad protection problems. They will be glad to consult with you and submit plans for enclosing yards or buildings, or to stop intrusion along the right of way.

There is a Page distributor right in your vicinity who maintains a complete organization. He will render an individual service obtainable through no other source.

Write for his name and interesting literature. No obligation.

Copper bearing steel, heavily galvanized after weaving. All fittings zinc coated to resist rust.

TRADE MARK
America's first wire fence since 1883

PAGE FENCE ASSOCIATION
215 North Michigan Ave., Chicago, Ill.
Dept. D8
Offices in All Principal Cities

PAGE Chain Link FENCE

An additional Factor of Safety on the DURABLE Posts

We have offset the increase in railroad car sizes and weights in the last few years by a still further increase in the strength of the DURABLE BUMPING POST.

The Improved Durable

A Durable Post must stop cars regardless of size or weight.

The additional factor of safety which we added is like the Durable Post itself—simple in construction but decidedly effective in use.

It consists of a heavy solid forged steel spreader bar placed between the bumping post rails where they join the running rails, with a heavy stirrup anchoring the center of the spreader bar to the tie immediately beneath it. It does the work—and it maintains the Durable's reputation—"IT STOPS THE CARS."

Mechanical Manufacturing Company

Union Stock Yards Chicago

Write for this Book!

ACIPCO MONO-CAST CENTRIFUGAL PIPE
BELL AND SPIGOT

EVERY pipe User should have full information about the method of manufacturing Mono-cast pipe, "every part of which is made at the same moment by centrifugal force." Our book on Acipco Mono-cast centrifugal pipe describes the manufacturing process in detail. It also presents valuable data on results of bursting, flexure and strip tests made recently with various types and classes of pipe.

Book will be sent to interested Engineers upon request to American Cast Iron Pipe Company, Birmingham, Ala.

We want to see you at the A. W. W. A. Convention, Chicago, June 6 to 11.

Mono-cast Pipe
Is free of casting strains.
Has greater ability to bend and to resist bending.
More endurance against impact and shock.
Is uniform in wall thickness.
Is 16 feet long.
Is Bell and Spigot with Bead Cast on.

AMERICAN CAST IRON PIPE COMPANY
ACIPCO MONO-CAST CENTRIFUGAL PIPE
BELL AND SPIGOT

This Wrought Iron Inter-Track Fence of special design is typical of Cyclone products which meet every railroad fencing requirement. Cyclone Fence, in wire or wrought iron, is the accepted standard for park, station, and inter-track use, and for enclosing yards, shops, terminals, and rights of way. Engineering assistance and estimates furnished without obligation. Phone, wire or write nearest offices.

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Main Offices, Waukegan, Ill.

Works and Offices:
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Newark, N. J., Fort Worth, Texas
Branch Offices in All Principal Cities
Pacific Coast Distributors:
Standard Fence Co., Oakland, Calif.
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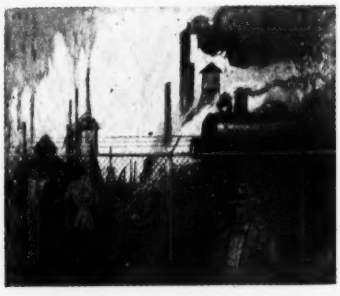
Cyclone Fence

REG. U.S. PAT. OFF.

CYCLONE FENCE COMPANY

The Mark of Dependable Property Protection

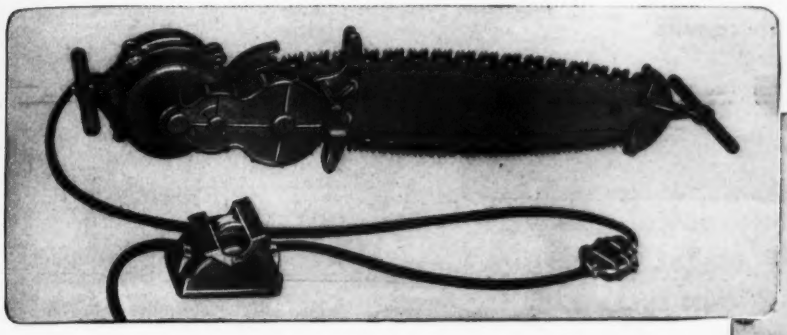


Invincible Chain Link Fence enclosing right of way

CYCLONE PROPERTY PROTECTION PAYS

© C.F.Co. 1927

For quicker and easier cutting of timber, piling, etc.



(Guard regularly supplied for top section of saw teeth)

CUTTING TIMBER

THE use of the "Wolf" Portable Link Sawing Machine in the railroad field is unlimited. For construction and repair of bridges, trestles, snowsheds, etc., the timbering of tunnels and in fact any operation requiring cross-cutting it is a time and labor saving investment.

Operates electrically on 110 or 220 volts, 60 cycle, 3 phase alternating current. Other A. C. voltages can be changed through the use of transformers while in cases where no power is available we can supply suitable portable motor generator set.

REED-PRENTICE CORPORATION
667-677 Cambridge St., Worcester, Mass.

WOODINGS TRACK TOOLS

Woodings Track Tools are made by men who have devoted the greater part of their lives to this kind of work. They are all veterans. This knowledge and careful workmanship, together with the use of the best grades of steel that we can obtain, are the causes of our increasing business.

We are receiving new orders every day from Roads pleased with former test orders.

Repeat orders are increasing daily, due to the service our tools are giving.

The Woodings Track Tools are rapidly becoming the Railroads' standard.

We follow your specifications closely and meet all of the requirements of your tests and inspection.

We respectfully solicit your consideration.

WOODINGS FORGE & TOOL CO.

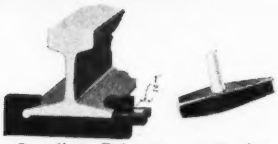
Works and General Sales Office
VERONA, PA.

The Bethco Rail Anchor

Stops the Rail—Stays Put—Easy to Install—Selflocking—Positive Grip—Adjustable, fits new, old, worn and corroded rails.

Hook long ear of Rail Anchor on rail base.

Key is ready to be driven.



Installed—Drive key until slot is ½-in. open.

Removing — Place a track punch or spike maul against the other end of the key and strike with hammer.

BETHLEHEM STEEL COMPANY *General Offices* **Bethlehem, Pa.**

District Offices in the following cities:

New York, Buffalo, Boston, Cleveland, Philadelphia, Cincinnati, Baltimore, Detroit, Chicago, Washington, St. Louis, Atlanta, San Francisco, Pittsburgh, Seattle, Portland, Los Angeles

Bethlehem Steel Corporation, 25 Broadway, New York City, Sole Export of Our Commercial Products

BETHLEHEM

DUFF JACKS

DUFF

"It's Light on Duff Jacks"

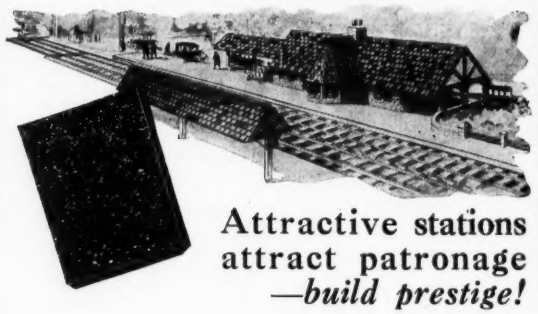
DUFF Track Jack
No. 117
Single Acting Type

DUFF Genuine Barrett Track Jacks — 15 Ton Capacity — are recognized as standard by leading Railroads of the world for construction, surfacing, repairing, and ballasting work. Superior construction provides greatest capacity with lightest weight.

DUFF Jacks meet all modern lifting requirements of Railroads at lower first cost, reduced labor and time expense, and with practically no maintenance.

Write for Detailed Information on Jacks in which you are especially interested.

The Duff Manufacturing Co.



Attractive stations attract patronage —*build prestige!*

Well kept buildings and equipment reflect the judgment and purpose of the organization behind the enterprise.

The railroad station is no exception. From its physical appearance, the public appraises the quality of the service to be expected.

Mule-Hide Giant Double Thick Individual Shingles are used extensively by railroads because they combine permanent beauty of color and design and provide extreme long wearing service. Aside from these features there is also to be considered the fire-resistant protection of the slate surfacing. Specifications: Size 12" x 15¾", weight 300 lbs. Colors: Red, Green, Blue Black, Golden Brown, Onyx, Terra Cotta and Rainbow. A pleasing blend is also obtained by mixing Green and Blue Black in the ratio of 30% Blue Black and 70% Green.

MULE-HIDE ROOFS

THE LEHON COMPANY
Manufacturers
W. 44th to 45th St. on Oakley Ave.
Chicago

MAGOR

AUTOMATIC AIR DUMP CARS

THE highly developed mechanical details of these cars assure satisfactory results; lower operating cost, greater safety in operation, quick and complete discharge are distinctive Magor features.

MAGOR CAR CORP.
30 Church St. New York N.Y.

Its use results in distinct savings!

There's a saving in using Barber Brand Cold Repair Cement because it is lower in cost and far more durable than planks for grade crossings, station platforms, foot walks, etc.

Another saving comes through the avoidance of accidents caused by broken planks with their resultant damage suits costing thousands of dollars.

Barber Brand Cold Repair Cement

also saves money in laying. Used COLD—right from the barrel—it requires no time, expense, or cumbersome equipment for heating.

That's why leading railroads use it—why you should write us for complete information.

THE BARBER ASPHALT COMPANY
1600 Arch Street, Philadelphia
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Save Old Switch Points!

Let us explain our new method of reclaiming worn switch points, sending them back into service to last longer than new ones. A practical economy you should not overlook.

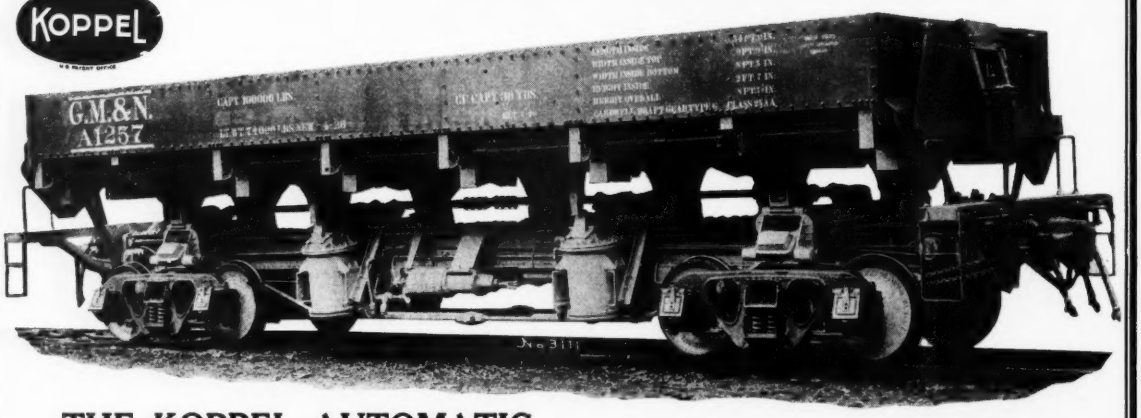
"Tym-Ber-Slab" Grade Crossings

are proving the most practical of any type now in use—They last longer—Smoother—Quickly installed—Remove and replace without damage—Cost no more—They are perfection—WRITE US

INTER-STATE CAR AND FOUNDRY CO.
INDIANAPOLIS, INDIANA

HERE IS A MIGHTY GOOD CAR!

KOPPEL



THE KOPPEL AUTOMATIC AIR DUMP CAR

Built to give service—positive in action—a clean, free discharge—either drop or lift door types available.
Drop Door Type—20 and 30 yds. capacity.
Lift Door Type—12, 16, 20, 30 and 50 yds. capacity.

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Koppel, Penna.

Sales Offices:

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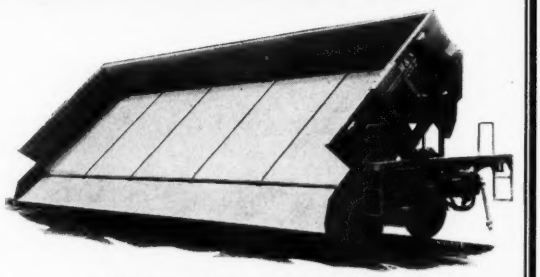

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ROYAL BLUE Boltless, Folding Double Deck Bunks

Set up—ready for use

Ideal for railroad construction camps, and cars

Made by

THE ROYAL BLUE BED SPRING CO.
formerly The M. A. Hunt Co.
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(Patented)

Kills Vegetation and Clears Frogs and Switches of Snow and Ice with Super-heated Steam

MAINTAINS A CLEAR TRACK AT ALL TIMES

Will not cause fires or poison stock.
Performs the work of many men.

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Increase the Life of the Tie.

Their installation will cut your Labor and Maintenance Cost.

Absolutely RUST-RESISTING.

Worth many times First Cost.

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Self-Boring Lag Screws for Signal Work.

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Bridge and Crossing Timbers.

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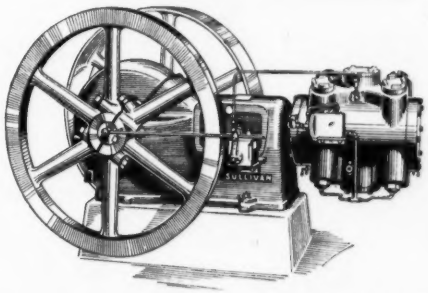
10 Features of the "WG-6" Mean Better Air Power Service



Ten important features enable the "WG-6" compressor to give you dependable, economical air power.

No Dust—Sure Lubrication
Main working parts are enclosed in a dust-tight housing and run in an oil bath. The cylinder is oiled by a reliable force-feed lubricator. Oil needs replenishing only at long intervals.

Wafer Valves
save power, and they are easy to get at and adjust.

"Sweep Control" Unloading Appliance
saves power by automatically interrupting compression whenever the desired pressure is reached; enabling the machine to run under no load until air is needed again.

7 Other Features
are described in the 16-page "WG-6" engineering catalog.

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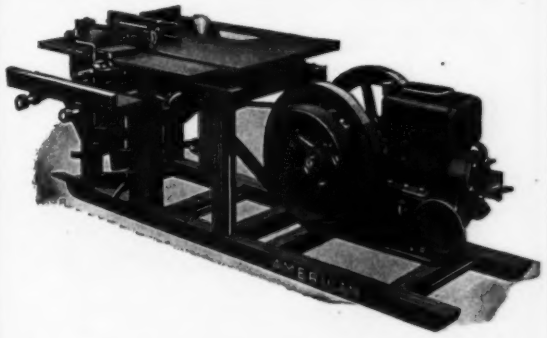

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Saw Mills, Woodworkers, Planers, Jointers, Band Saws, Re-saws, Cut-off Saws.

Ask for Complete Catalog

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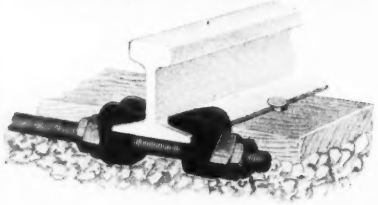
164 Main Street **Hackettstown, N. J.**

"Anchor" Track Braces



Patented Nov. 16, 1926
They hold the rail like in a vise. The lugs are self adjusting, so that one size brace fits on six different weights of rail.

A simple low cost device for strengthening the track at weak or defective places. Use a few Anchor Track Braces at sharp curves, switches, places where the ties are rotten, or where the spikes are loose, or at any bad part of the track where needed. Usually one brace about every three yards is sufficient.

They prevent track spreading, rails turning or creeping, spikes lifting and similar troubles. Are a time saver for quick repairs. Will strengthen temporary tracks. Can be installed by one man in four minutes, and used over and over again. Are furnished insulated if desired. Send for bulletin.

Manufactured by

T. H. EDELBLUTE COMPANY
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Also manufacturers of "Anchor" Rerailers

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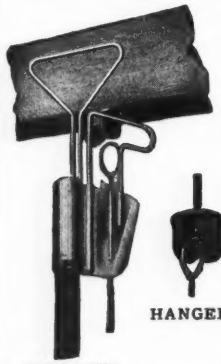
TELL-TALES On Bridge and Tunnel Warnings



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REPLACER

Can now be taken down and replaced by one man from the ground.
No more need of sending a crew of 3 or 4 men over your road with a long ladder, and climbing to the cross arm.
No more tangling of tell-tales.
BRONZE HANGERS — no corrosion or rust — everlasting — TELL-TALES of spring brass rods and treated rope, most resistant to bending.
You can eliminate almost your entire labor and replacement costs and make your bridge and tunnel warnings 100% efficient.
Avoid death and injuries to employees.

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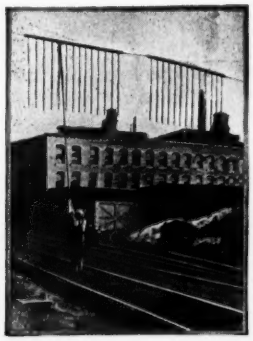

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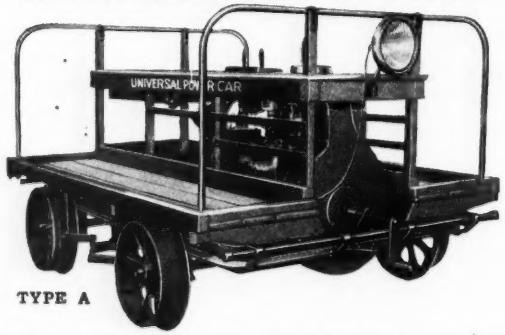
UNIVERSAL POWER CAR
FOR MAINTENANCE-OF-WAY FORCES



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Takes the men to the job and works when it gets there

A GAS-ELECTRIC POWER PLANT

Develops 110 volts a.c. and d.c. current for operating all Electric Tools such as Grinding Tools, Portable Rail Saws, Track and Bonding Drills, Electric Tie Tampers, Flood Lighting Systems, Portable Saws and Boring Tools for Carpenters and Bridge Gangs, Electric Driven Air Compressors for Sand-Blasting and Paint Spraying, and all other Electric Tools Essential to maintenance work.

DEPENDABLE—ECONOMICAL—FLEXIBLE
CAN BE OPERATED BY UNSKILLED WORKMEN
Electrically Driven, No Friction Discs, Gear Shifts or Clutches
Four men Can Easily Remove Car from Tracks

THE EUCLID ELECTRIC & MFG. CO.
EUCLID, OHIO

HUNT

Special H Inspection

of Rails

Is Used By

More Than Half

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Railway Mileage
of the
United States

Robert W. Hunt Co.
Engineers
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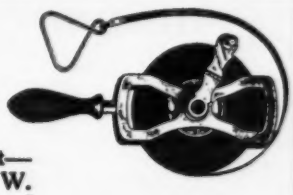
STURDY AND RELIABLE

LUFKIN TAPES



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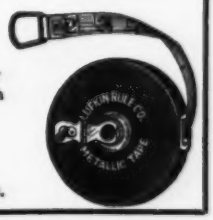

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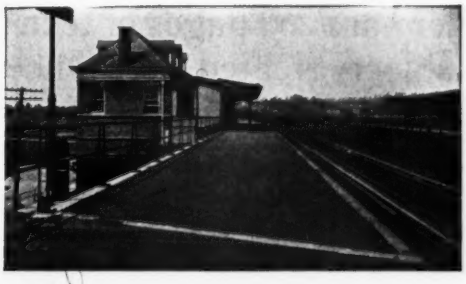
for Safety and long wear



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SAFETY, appearance and long wear at a minimum cost for laying and maintenance best meet the present day requirements for railway station platforms. All of these essential features are found to the highest degree in Headley No. 1 especially prepared to render exceptional low cost service wherever a smooth, tough operating surface is demanded.

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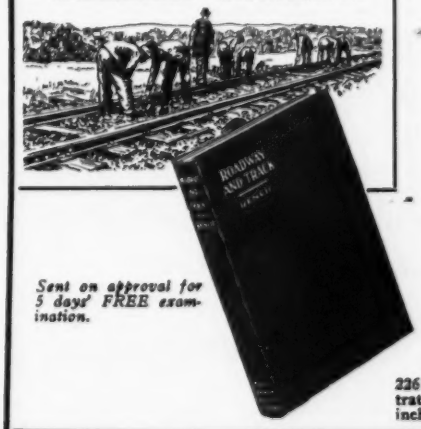

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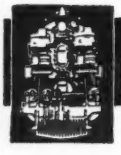

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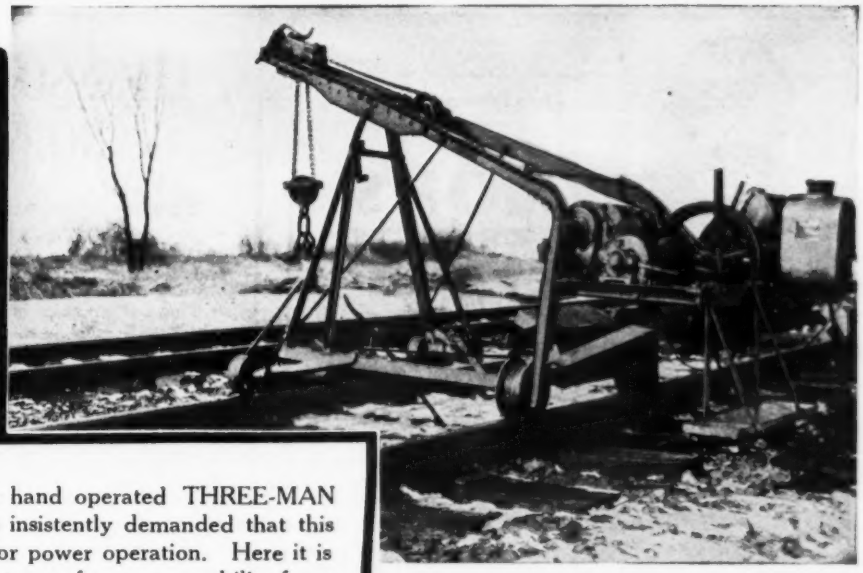

MANY users of the hand operated THREE-MAN Rail Layer have insistently demanded that this machine be equipped for power operation. Here it is —retaining the same features of easy removability from track which distinguish the hand operated machine.

More than 100 railroads have adopted and used the hand operated THREE-MAN Rail Layer—hundreds of repeat orders. Operation by power makes the daily capacity of this machine even greater. It can handle with ease the heaviest 39 ft. rails.

Power Operated THREE-MAN Rail Layer. In operation a cover completely encloses all moving or working parts, protecting workmen against accidents and protecting the machinery against the weather.

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Will you please let us have your specifications for water treating plants?

We are qualified by organization and experience to give you service. Write for our literature.

AMERICAN WATER SOFTENER CO.

FAIRHILL P. O. PHILADELPHIA, PA.

Specialists for twenty-four years in Railroad

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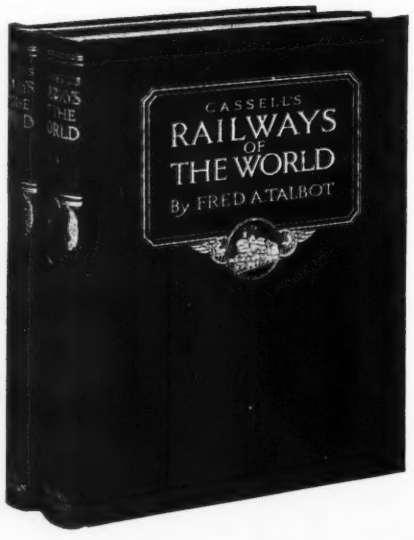

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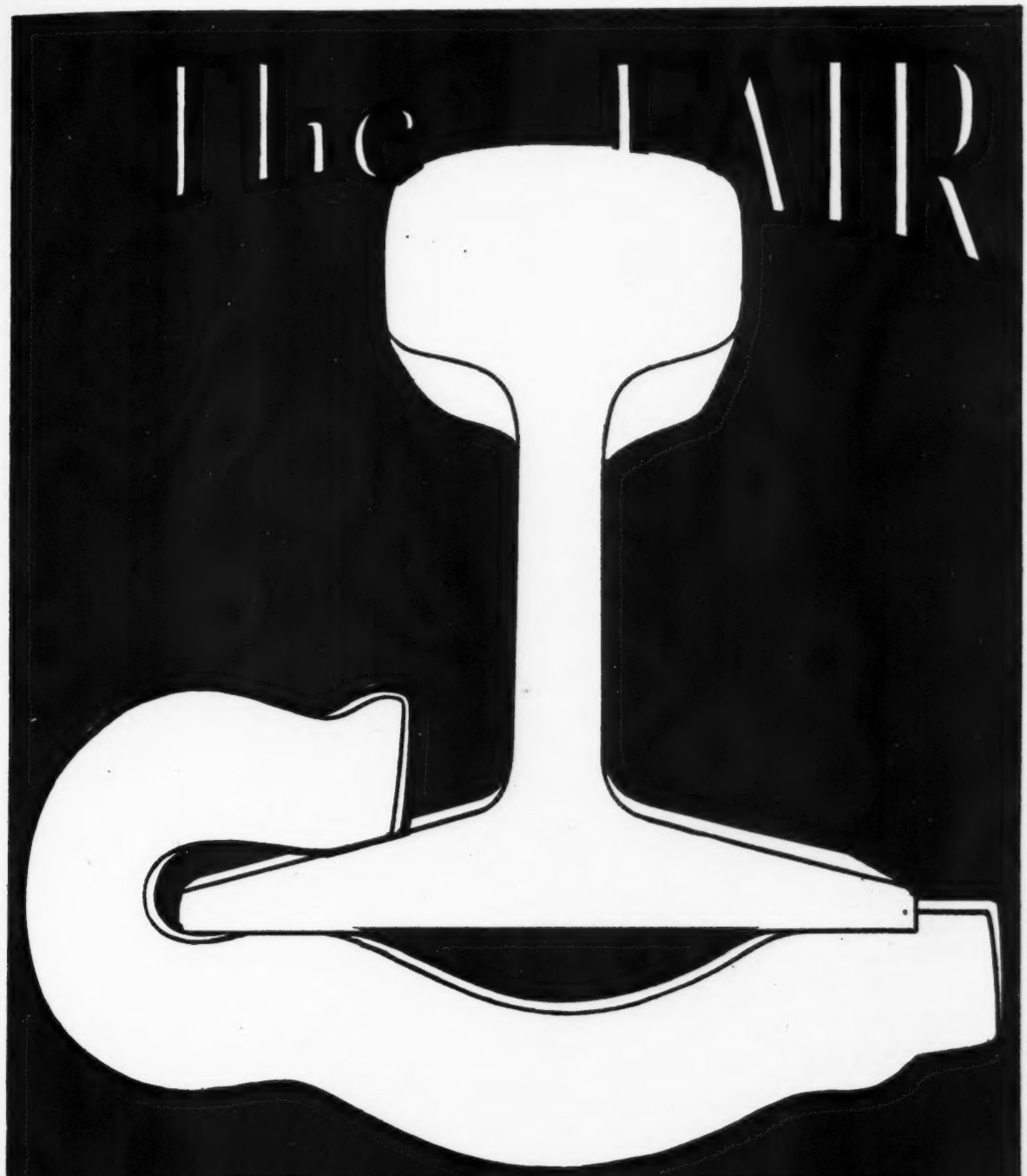

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Mudge & Co.
Northwestern Motor Co.

Cars, Industrial
Clark Car Co.
Koppel Industrial Car & Equipment Co.
Magor Car Corp.
Western Wheeled Scraper Co.

Cars, Inspection
Buda Co.
Euclid Electric & Mfg. Co.
Fairbanks, Morse & Co.
Fairmont Railway Motors, Inc.
Kalamazoo Railway Supply Co.
Mudge & Co.
Northwestern Motor Co.
Woolery Machine Co.

Cars, Motor
Buda Co.
Euclid Elecric & Mfg. Co.
Fairbanks, Morse & Co.
Fairmont Ry. Motors, Ins.
Kalamazoo Ry. Supply Co.
Mudge & Co.
Northwestern Motor Co.
Woolery Machine Co.

Cars, Section
Buda Co.
Fairbanks, Morse & Co.
Fairmont Railway Motors, Inc.
Kalamazoo Railway Supply Co.
Mudge & Co.
Northwestern Motor Co.
Woolery Machine Co.

Car, Spreader
Clark Car Co.
Jordan Co., O. F.
Western Wheeled Scraper Co.

Car Stop, Friction
Maintenance Equipment Co.

Cars, Velocipede
Buda Company
Fairbanks, Morse & Co.
Kalamazoo Railway Supply Co.

Castings
Bethlehem Steel Co.
Louisville Frog & Switch Co., Inc.
Wharton, Jr. & Co., Inc., Wm.

Cattle Guards
Fairbanks, Morse & Co.
Kalamazoo Railway Supply Co.

Cattle Passes
Massey Concrete Products Corp.

Cement, High Temperature
Johns-Manville Corp.

Cement Repair
Barber Asphalt Co.
Carey Co., Philip

Clamshell Buckets
See Buckets, Clamshell

Coal Handling Machinery
Hayward Co.

Coal, Ore & Ash Handling Machinery
McMyler Interstate Co.

Coaling Stations
Fairbanks, Morse & Co.

Compressors
Ingersoll-Rand Co.
Sullivan Machinery Co.

Compromise Joints
See Joints, Compromise

Concrete Units, Miscellaneous
Federal Cement Tile Co.
Massey Concrete Prod. Corp.
R. C. Products Co., Inc.

Condensers
Ingersoll-Rand Co.

Conveying Machinery
McMyler Interstate Co.

Corrugated Iron
Armco Culvert & Flume Mfrs. Ass'n.

Cots
Royal Blue Bed Spring Co.

Counterweight Drums
Hayward Co.

Cranes, Barge, Electric Erecting, Gantry, Locomotive, Pillar, Transfer, Tunnel, Wharf and Wrecking
Interstate Car & Foundry Co.
McMyler Interstate Co.

Creosoted Timber
See Timber, Creosoted

Cribbing, Concrete
Federal Cement Tile Co.
Massey Concrete Products Corp.
R. C. Products Co., Inc.

Crossing Gates
Buda Co.
Kalamazoo Railway Supply Co.

Crossings, Highway
Carey Co., Philip
Headley Good Roads Co.
Kentucky Rock Asphalt Co.

Crossings, Rail
Bethlehem Steel Co.
Buda Co.
Interstate Car & Foundry Co.
Louisville Frog & Switch Co., Inc.
Ramapo Ajax Corp.
Wharton Jr. & Co., Wm.

Crushers, Stone
Western Wheeled Scraper Co.

Culvert Pipe
American Casting Co.
American Cast Iron Pipe Co.
Armco Culvert & Flume Mfrs. Ass'n.
Central Alloy Steel Corp.
Massey Concrete Products Corp.

Curbing
Massey Concrete Products Corp.

Derails
Q & C Co.
Wharton Jr. & Co., Wm.

Derrick Cars
Maintenance Equipment Co.

Derricks
McMyler Interstate Co.

Diesel Engines
Fairbanks, Morse & Co.
Ingersoll-Rand Co.

Diesel Electric Power Plants
Fairbanks, Morse & Co.
Ingersoll-Rand Co.

Discing Machines
Fairmont Railway Motors, Inc.

Disinfectants
Chipman Chemical Engineering Co.

Ditchers
Jordan Co., O. F.

Ditching Machinery
McMyler Interstate Co.

Drains, Perforated
Central Alloy Steel Corp.

Dredging Machinery
McMyler Interstate Co.

Drills, Earth
Buda Co.

Drills, Pneumatic
Ingersoll-Rand Co.

Drills, Rock
Ingersoll-Rand Co.
Sullivan Machinery Co.
Verona Tool Works

Drill Steel, Rock
Ingersoll-Rand Co.
Sullivan Machinery Co.

Drills, Track
Buda Co.
Ingersoll-Rand Co.
Kalamazoo Railway Supply Co.
Railroad Accessories Corp.

Dump Cars
Clark Car Co.
Differential Steel Car Co.
Koppel Industrial Car & Equipment Co.
Jordan Co., O. F.
Western Wheeled Scraper Co.

Dynamite
Du Pont de Nemours & Co., Inc., E. I.

Electric Cranes (Locomotive, Pillar, Transfer & Wrecking)
See Cranes

Electric Light & Power Plants
Fairbanks, Morse & Co.

Electric Power Units
Euclid Electric Co.
Northwestern Motor Co.
Syntron Co.

Electric Snow Melters
Q & C Co.

Engines, Gasoline
Buda Co.
Fairbanks, Morse & Co.
Fairmont Railway Motors, Inc.
Ingersoll-Rand Co.
Kalamazoo Railway Supply Co.
Mudge & Co.
Northwestern Motor Co.
Woolery Machine Co.

Engines, Hoisting
McMyler Interstate Co.

Engines, Motor Car
Buda Co.
Euclid Electric & Mfg. Co.
Fairbanks, Morse & Co.
Fairmont Railway Motor Co.
Kalamazoo Railway Supply Co.
Mudge & Co.
Northwestern Motor Co.
Woolery Machine Co.

Engines, Oil
Buda Co.
Fairbanks, Morse & Co.
Ingersoll-Rand Co.

Explosives
Du Pont de Nemours & Co., Inc., E. I.

Fences
Cyclone Fence Co.
Page Fence Association
Q & C Co.

Fence, Fabric
Cyclone Fence Co.
Page Fence Association

Fence Posts
Maintenance Equipment Co.
Massey Concrete Products Corp
Page Fence Association
Q & C Co.

Fibre Angle Pieces, Bushings, Plates, etc.
Q & C Co.

Fibre Insulating
Q & C Co.

Filters
American Water Softener Co.

Fire Fighting and Protection Equipment
Johns-Manville Corp.

Flangers, Snow
Q & C Co.

Float Valves
Fairbanks, Morse & Co.

Floor Coverings
Barber Asphalt Co.
Lehon Co.

Flooring Compositions
Johns-Manville Corp.

Forgings
Bethlehem Steel Co.
Interstate Car & Foundry Co.
McMyler Interstate Co.

Frogs
Bethlehem Steel Co.
Buda Co.
Conley Frog & Switch Co.
Interstate Car & Foundry Co.
Louisville Frog & Switch Co., Inc.
Ramapo Ajax Corp.
Wharton Jr. & Co., Inc., Wm.

Gages, Measuring
Lufkin Rule Co.

Gages, Pressure Gas
Oxweld Railroad Service Co.

Gas, Acetylene
Oxweld Railroad Service Co.

Graders, Elevating
Western Wheeled Scraper Co.

Grading Machinery
Western Wheeled Scraper Co.

Graphite
Dixon Crucible Co., Jos.

Grinders, Portable
Buda Co.
Ingersoll-Rand Co.

Guard Rails
Bethlehem Steel Co.
Buda Co.
Louisville Frog & Switch Co., Inc.
Q & C Co.
Ramapo Ajax Corp
Wharton Jr. & Co., Wm.

Guard Rail Clamps
Bethlehem Steel Co.
Buda Co.
Louisville Frog & Switch Co., Inc.
Q & C Co.
Ramapo Ajax Corp.
Wharton Jr. & Co., Wm.

Hammers, Chipping, Scaling and Caulking
Ingersoll-Rand Co.

Hammer Drills
Ingersoll-Rand Co.
Sullivan Machinery Co.

Hammers, Forge
Sullivan Machinery Co.

Hammers, Riveting
Ingersoll-Rand Co.
Sullivan Machinery Co.

Hand Car Bearings
Hyatt Roller Bearing Co.
Timken Roller Bearing Co.

Head Drains, Perforated
Central Alloy Steel Corp.

Heaters, Feed Water
American Water Softener Co.

Highway Crossings
Barber Asphalt Co.
Headley Good Roads Co.
Ohio Valley Rock Asphalt Co.

Hoisting Machinery
Brown Hoisting Machinery Co.
Fairbanks, Morse & Co.
Ingersoll-Rand Co.
McMyler Interstate Co.

Hoists, Air Motor
Ingersoll-Rand Co.

Hose
Ingersoll-Rand Co.

House Lining
Barber Asphalt Co.
Lehon Co.

Inspection Cars
See Cars, Inspection

Inspection, Engineering
Hunt Co., Robert W.

Insulated Rail Joints
Bethlehem Steel Co.
Q. & C Co.
Rail Joint Co.

Insulating Material
Barber Asphalt Co.
Johns-Manville Corp.
Lehon Co.

Jacks, Automatic Lowering; Lifting; Horizontal; Pull & Push
Duff Manufacturing Co.
Norton Co., A. O.

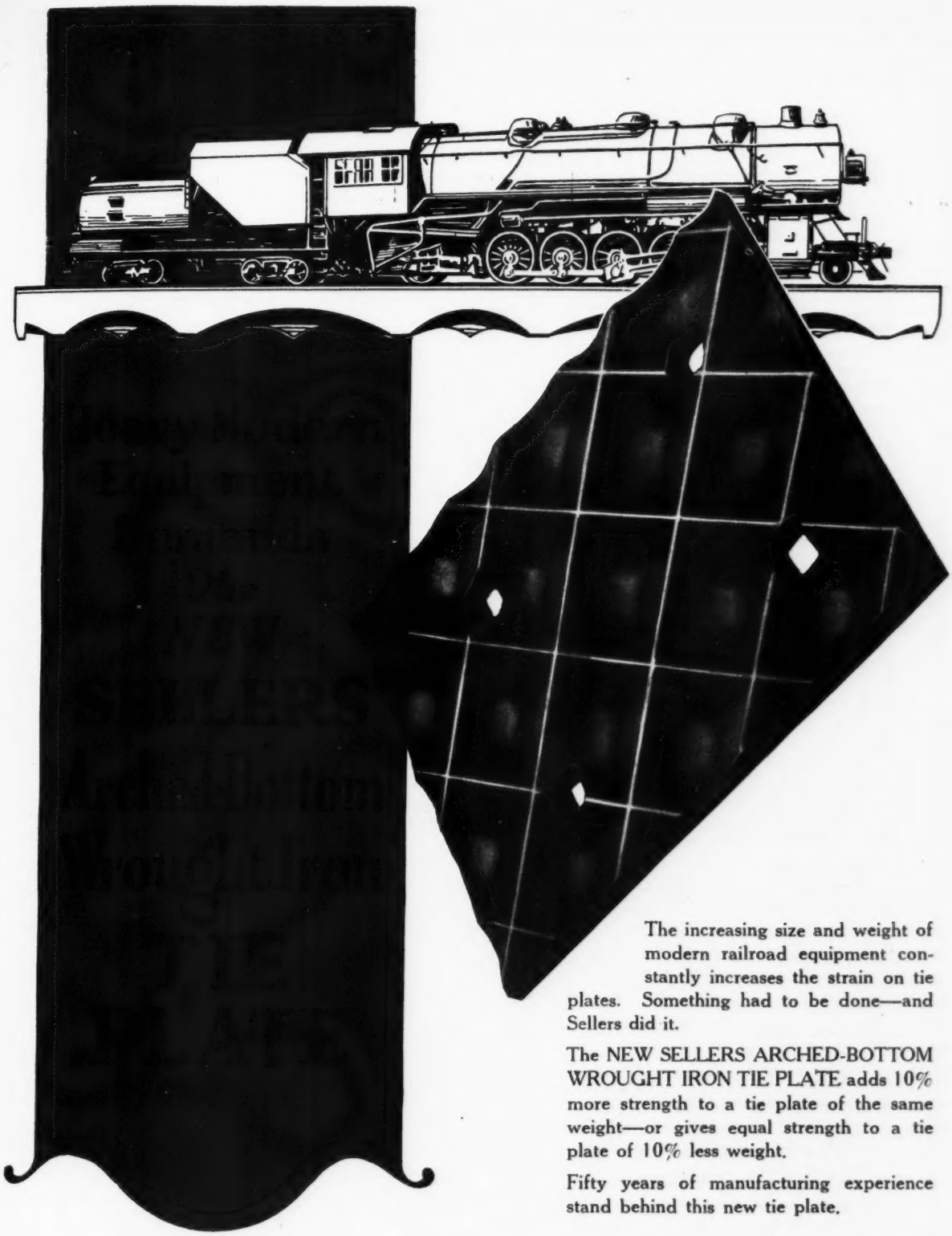
Jacks, Ball Bearing Screw; Governor Controlled
Duff Manufacturing Co.
Norton Co., A. O.

Jacks, Pole; Pipe Forcing; Special Purpose
Duff Manufacturing Co.

Jacks, Bridge
Buda Co.
Duff Manufacturing Co.
Kalamazoo Railway Supply Co.
Norton Co., A. O.

Jacks, Smoke
Johns-Manville Corp.

Jacks, Track
Buda Company
Duff Manufacturing Co.
Hackmann Railway Supply Co.
Kalamazoo Railway Supply Co.
Norton Co., A. O.
Verona Tool Works



The increasing size and weight of modern railroad equipment constantly increases the strain on tie plates. Something had to be done—and Sellers did it.

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BUYERS' GUIDE

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Bethlehem Steel Co.
Q & C Co.
Rail Joint Co.

Joint Fastenings
Illinois Steel Co.

Joints, Rail
Bethlehem Steel Co.
Q & C Co.
Rail Joint Co.
Wharton Jr. & Co., Wm.

Joints, Step
Inland Steel Co.
Q & C Co.
Rail Joint Co.

Junction Boxes
Massey Concrete Products Corp.

Knuckles, Emergency
Q & C Co.

Liners, Track
Chicago Steel Foundry Co.
Hackmann Railway Supply Co.
Rail Joint Co.

Lock Washers
National Lock Washer Co.
Reliance Manufacturing Co.

Locomotives, Oil Engine Electric Driven
Ingersoll-Rand Co.

Lubricants
Dixon Crucible Co., Jos.

Lumber, Asbestos
Jonns-Manville Corp.

Manganese Track Work
Bethlehem Steel Co.
Buda Co.
Ramapo Ajax Corp.
Wharton Jr. & Co., Wm.

Manholes
Massey Concrete Products Corp.

Markers
Massey Concrete Products Corp.

Mechanical Painting Equipment
Matthews Corp., W. N.

Mile Posts
Massey Concrete Products Corp.

Motor Bearings
Hyatt Roller Bearing Co.
Timken Roller Bearing Co.

Motor Car Accessories
Mudge & Company

Motor Cars
See Cars, Motor

Motors and Generators
Fairbanks, Morse & Co.

Mowing Machines
Fairmont Railway Motors, Inc.
Mudge & Co.

Nut Locks
National Lock Washer Co.
Reliance Manufacturing Co.
Verona Tool Works
Woodings Forge & Tool Co.

Nuts
Bethlehem Steel Co.
Graham Bolt & Nut Co.
Illinois Steel Co.
Interstate Car & Foundry Co.

Oil Engines
See Engines, Oil

Out Houses
Massey Concrete Products Corp.

Oxygen
Oxweld Railroad Service Co.

Oxy-Acetylene Welding Equipment
Oxweld Railroad Service Co.

Packing, Asbestos
Johns-Manville Corp.

Paint
Dixon Crucible Co., Jos.

Paint, Metal Protecting
Barber Asphalt Co.
Dixon Crucible Co., Jos.

Paint Spraying Equipment
Matthews Corp., W. N.

Pavement Breakers
Ingersoll-Rand Co.
Sullivan Machinery Co.

Penstocks
Fairbanks, Morse & Co.

Pile Drivers
McMyler Interstate Co.
Ingersoll-Rand Co.

Piling
International Creosoting & Construction Co.
Massey Concrete Products Corp.

Pinion Puller
Duff Manufacturing Co.

Pipe, Cast Iron
American Casting Co.
American Cast Iron Pipe Co.
Cast Iron Pipe Publicity Bureau
U. S. Cast Iron Pipe & Foundry Co.

Pipe Carriers
Massey Concrete Products Corp.

Pipe, Concrete
Massey Concrete Products Corp.

Pipe, Corrugated
Armco Culvert & Flume Mfrs. Ass'n

Pipe, Sewer
American Casting Co.
Massey Concrete Products Corp.

Pipe Joint Compound
Dixon Crucible Co., Jos.

Platforms, Station
Headley Good Roads Co.
Kentucky Rock Asphalt Co.

Plows, Railroad
Western Wheeled Scraper Co.

Poles
International Creosoting & Construction Co.
Massey Concrete Products Corp.

Post Hole Digger
Buda Company

Posts, Fence
See Fence Posts

Posts, Bumping
See Bumping Posts

Powders
Du Pont de Nemours & Co., Inc., E. I.

Power Plants, Portable
Northwestern Motor Co.
Syntron Co.

Preformed Track Pavement
Carey Co., Philip

Preservation, Timber
International Creosoting & Construction Co.

Products, Gas
Oxweld Railroad Service Co.

Pumps, Air Pressure & Vacuum, Centrifugal, Deep Well, Piston, Plunger, Rotary, Slump
American Well Works
Fairbanks, Morse & Co.
Ingersoll-Rand Co.
Sullivan Machinery Co.

Push Cars
Buda Company
Fairbanks, Morse & Co.
Fairmont Railway Motors, Inc.
Kalamazoo Railway Supply Co.
Mudge & Co.

Push Car Bearings
Hyatt Roller Bearing Co.
Timken Roller Bearing Co.

Rail Anchors
American Fork & Hoe Co.
Bethlehem Steel Co.
Lundie Engineering Corp.
P. & M. Co.
Verona Tool Works

Rail Anti-Creepers
See Anti-Creepers, Rail

Rail Benders
Buda Co.
Louisville Frog & Switch Co., Inc.
Q & C Co.
Verona Tool Works

Rail Bonds
Verona Tool Works

Rail Braces
Bethlehem Steel Co.
Buda Co.
Louisville Frog & Switch Co., Inc.
Q & C Co.
Ramapo Ajax Corp.
Wharton Jr., & Co., Wm.

Rail Expanders
Ramapo Ajax Corp.

Rail Joints
See Joints, Rail

Rail Layers
Maintenance Equipment Co.
Parsons Co.

Rail Saws, Portable
Kalamazoo Railway Supply Co.
Q & C Co.

Rail Springs
Verona Tool Works

Rails, Girder
Bethlehem Steel Co.

Rail Shim
American Fork & Hoe Co.

Rails, Tee
Bethlehem Steel Co.
Inland Steel Co.

Regulators, Oxy-Acetylene
Oxweld Railroad Service Co.

Removers, Paint
Mudge & Co.

Replacers, Car
Buda Co.
Q & C Co.

Retaining Walls, Precast
Federal Cement Tile Co.
Massey Concrete Product Corp.
R. C. Products Co., Inc.

Rivets
Bethlehem Steel Co.
Louisville Frog & Switch Co., Inc.

Rods, Welding
Oxweld Railroad Service Co.

Roof Slabs
Federal Cement Tile Co.
Massey Concrete Products Corp.

Roofing, Asbestos
Johns-Manville Corp.

Roofing Composition
Barber Asphalt Co.
Lehon Co.

Roofing, Corrugated
Johns-Manville Corp.

Rules
Lufkin Rule Co.

Saw Mills
American Saw Mill Machy. Co.

Saws, Electric
Reed-Prentice Corp.

Saws, High Speed Friction
American Saw Mill Machy. Co.

Saw Rigs
American Saw Mill Machy. Co.
Fairbanks, Morse & Co.

Scales, Tape
Lufkin Rule Co.

Scales, Track
Fairbanks, Morse & Co.

Scrapers, Wheel, Drag & Buck
Western Wheeled Scraper Co.

Screw Spikes
Malleable Screw Products, Inc.

Screw Spike Drivers
Ingersoll-Rand Co.

Section Cars
See Cars, Section

Sharpeners, Rock Drill Steel
Ingersoll-Rand Co.

Sheathing Paper
Barber Asphalt Co.
Lehon Co.

Sheet Iron
Armco Culvert & Flume Mfrs. Ass'n.

Sheets, Corrugated
Johns-Manville Corp.

Sheet Steel
Inland Steel Co.

Shingles, Composition
Barber Asphalt Co.
Lehon Co.

Shovels
Ames Shovel & Tool Co.
Interstate Car & Foundry Co.
Verona Tool Works
Woodings Forge & Tool Co.

Siding, Corrugated and Plain
Johns-Manville Corp.

Signal Foundations, Concrete
Massey Concrete Products Corp.

Signals, Bridge Warnings
Hastings Signal & Equip. Co.

Skid Excavators & Dredges
Hayward Co.

Skid Shoes
Q & C Co.

Slabs, Concrete
Massey Concrete Products Corp.

Smoke Stacks
Massey Concrete Products Corp.

Snow Melting Devices
Q & C Co.

Snow Plows
Jordan Co., O. F.
Q & C Co.

Spike Pullers
Louisville Frog & Switch Co., Inc.

Spikes
Bethlehem Steel Co.

Spreader Cars
See Cars, Spreader

Spreaders, Ballast
See Ballast Spreaders

Standpipes (Penstock)
Fairbanks, Morse & Co.

Stands, Switch & Target
Bethlehem Steel Co.
Q & C Co.
Ramapo Ajax Corp.

Steel, Alloy
Central Alloy Steel Corp.

Steel Plates and Shapes
Bethlehem Steel Co.

Step Joints
See Joints, Step.

Storage Tanks
Pittsburgh Des Moines Co.

Structural Steel
Bethlehem Steel Co.

Switches
Bethlehem Steel Co.
Buda Company
Conley Frog & Switch Co.
Interstate Car & Foundry Co.
Louisville Frog & Switch Co., Inc.
Ramapo Ajax Corp.
Wharton Jr. & Co., Wm.

Switchmen's Houses
Massey Concrete Products Corp.

Switchpoint Protector
Maintenance Equipment Co.

Switchstands & Fixtures
Bethlehem Steel Co.
Buda Co.
Ramapo Ajax Corp.
Wharton Jr. & Co., Wm.

Tampers, Tie
See Tie Tampers

Tank Fixtures
Fairbanks, Morse & Co.

Tanks, Steel
Pittsburgh Des Moines Co.

Tape, Insulating
Johns-Manville Corp.

Tapes, Measuring
Lufkin Rule Co.

Tee Rails
See Rails, Tee.

Telephone Service, Long Distance
American Telephone & Telegraph Co.

Telegraph Poles
See Poles

Telegraph Service, Long Distance
American Telephone & Telegraph Co.

Telltales
Hastings Signal & Equipment Co.

Testing of Materials
Hunt Co., Robert W.

Thawing Outfits
Q & C Co.

Thermit Welding
Metal & Thermit Corp.

Ties
International Creosoting & Construction Co.

Tie Plates
Bethlehem Steel Co.
Illinois Steel Co.
Lundie Engineering Corp.
Sellers Manufacturing Co.
Illinois Steel Co.

Tie Plate Clamps
Q & C Co.

Tie Rods
Bethlehem Steel Co.

Tie Spacers
Duff Manufacturing Co.
Maintenance Equipment Co.

Tie Tampers
Electric Tamper & Equipment Co.
Ingersoll-Rand Co.
Syntron Co.

Timber, Bridge
Interstate Car & Foundry Co.

Timber, Creosoted
International Creosoting & Construction Co.

Timber, Slab
Interstate Car & Foundry Co.

Tile, Roofing
Federal Cement Tile Co.

Tools, Oxy-Acetylene Cutting & Welding
Oxweld Railroad Service Co.

Tools, Pneumatic
Ingersoll-Rand Co.

Tools, Track
Ames Shovel & Tool Co.
Buda Co.
Maintenance Equip. Co.
Q & C Co.
Verona Tool Works
Woodings Forge & Tool Co.

Tongue Switches
Bethlehem Steel Co.
Buda Co.
Ramapo Ajax Corp.
Wharton Jr. Co., Wm.

Torches, Oxy-Acetylene Cutting & Welding
Oxweld Railroad Service Co.

Track Drills
See Drills, Track

Track Gages
Buda Co.
Kalamazoo Railway Supply Co.
Louisville Frog & Switch Co., Inc.

Track Jacks
See Jacks, Track

Track Liners
See Liners, Track

Track, Portable
Western Wheeled Scraper Co.

Track Tools
See Tools, Track

Treating Plants, Water
American Water Softener Co.

Trestle Slabs
Massey Concrete Products Corp.

Tunnel Warnings
Hastings Signal & Equipment Co.

Ventilators
Johns-Manville Corp.

Warning Devices, Bridge & Tunnel
Hastings Signal & Equipment Co.

Water Softening Plants
American Water Softening Co.

Water Tanks
Pittsburgh Des Moines Co.

Water Treating Plants
American Water Softening Co.

Waterproofing Fabrics
Barber Asphalt Co.
Johns-Manville Corp.
Lehon Co.

Weed Burner
Dean-Williams Weed Destroyer Co.
Woolery Machine Co.

Weed Killer
Chipman Chemical Engineering Co., Inc.
Dean-Williams Weed Destroyer Co.
Q & C Co.

Welding, Oxy-Acetylene
Metal & Thermit Corp.
Oxweld Railroad Service Co.

Welding & Cutting Equipment
Oxweld Railroad Service Co.

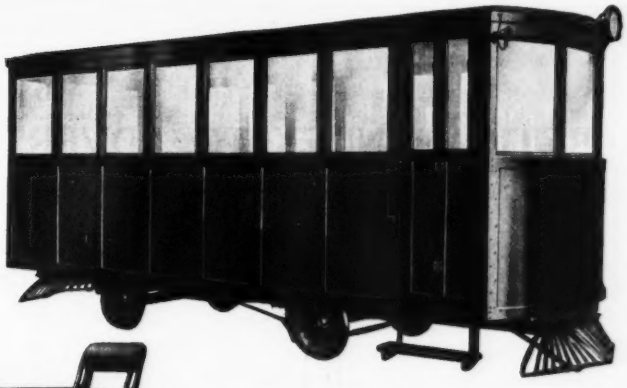
Wheels, Hand & Motor Car
Buda Co.
Fairbanks, Morse & Co.
Fairmont Railway Motors, Inc.
Kalamazoo Railway Supply Co.
Mudge & Co.
Northwestern Motor Co.
Woolery Machine Co.

Windshields
Mudge & Co.
Fairbanks, Morse & Co.

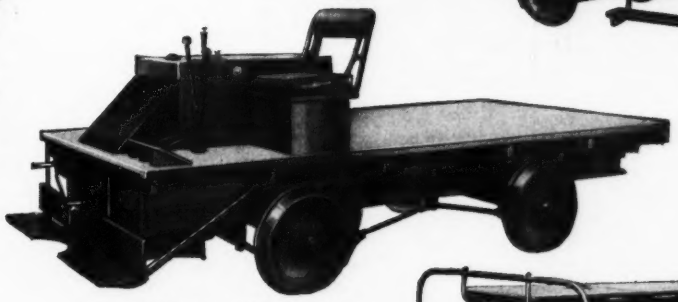
Wire Fencing
Cyclone Fence Co.
Page Fence Association

Wood Preservation
See Preservation, Timber

Woodworking Machinery
American Saw Mill Machinery Co.

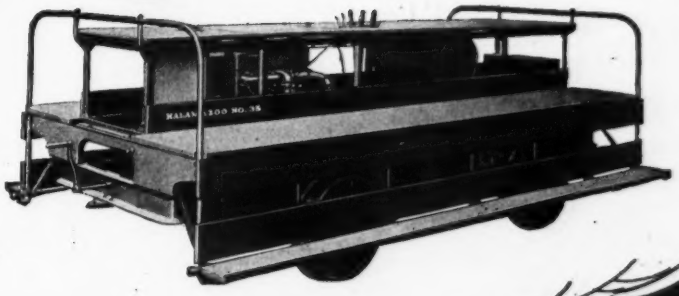


Kalamazoo "355" a completely enclosed, all-weather Coach-Type Motor Car seating 22 men. Widely used for hauling workmen to and from the job the year 'round. Double-end control.



Kalamazoo "35B" Flat Decked Work Car. A tremendously powerful car for hauling materials and workmen. Handles several trailers easily.

The Kalamazoo "35" Motor Car with standard body seating 30 men. Hauls many more on trailers.



Locomotives

KALAMAZOO RAILWAY SUPPLY COMPANY

ESTABLISHED 1884

KALAMAZOO MICHIGAN

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St. Louis
St. Paul

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Denver
Spokane
Seattle

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Havana
London
Mexico City

Johannesburg
Vancouver
Winnipeg
Montreal

ALPHABETICAL INDEX TO ADVERTISERS

A

American Cast Iron Pipe Company 56
American Castings Company 54
American Saw Mill Machinery Company 61
American Telephone & Telegraph Co. 39
American Water Softener Company 66
American Well Works 10
Ames Shovel & Tool Company 25
Armco Culvert & Flume Mfrs.' Ass'n 12

B

Barber Asphalt Company 59
Bethlehem Steel Company 58
Brown Hoisting Machinery Company 44
Buda Company 14

C

Carey Co., Philip 8, 9
Cast Iron Pipe Publicity Bureau 23
Central Alloy Steel Corp. 48
Chicago Steel Foundry Company 54
Chipman Chemical Engineering Corp. 41
Clark Car Company 52
Conley Frog & Switch Company 5
Cyclone Fence Company 56

D

Dean-Williams Weed Destroyer Company 60
Differential Steel Car Company 46
Dixon Crucible Company, Jos. 66
Duff Manufacturing Company 58
Du Pont de Nemours & Co., Inc., E. I. 36

E

Edelblute Company, T. H. 62
Euclid Electric & Manufacturing Company 62

F

Fairbanks, Morse & Company 19, 20
Fairmont Railway Motors, Inc. 24
Federal Cement Tile Company 15

G

Graham Bolt & Nut Company 32

H

Hackmann Railway Supply Company 6
Hastings Signal & Equipment Company 62
Hayward Company 37
Headley Good Roads Company 63
Hunt Company, R. W. 62
Hyatt Roller Bearing Company 7

I

Ingersoll-Rand Company 33
Illinois Steel Company 21
International Creosoting & Construction Company 28
Interstate Car & Foundry Company 59

J

Johns-Manville Corp. 18
Jordan Company, O. F. 17

K

Kalamazoo Railway Supply Company 71
Kentucky Rock Asphalt Company 53
Koppel Industrial Car & Equipment Company 60

L

Lehon Company 58
Louisville Frog & Switch Company 29
Lufkin Rule Company 63
Lundie Engineering Corp. 31

M

Magor Car Corp. 59
Maintenance Equipment Company 65
Malleable Screw Products, Inc. 61
Massey Concrete Products Corp. 30
Matthews Corp., W. N. 43
McMyler Interstate Company 16
Mechanical Manufacturing Company 55
Metal & Thermit Corp. 34
Mudge & Company 3

N

National Lock Washer Company 1
Northwestern Motor Company 51
Norton Company, A. O. 65

O

Ohio Valley Rock Asphalt Company 38
Owen Bucket Company 50
Oxweld Railroad Service Company 11

P

P & M Company 67
Page Fence Association 55
Pittsburgh-Des Moines Steel Company 47

Q

Q & C Company 73

R

R. C. Products Company 13
Rail Joint Company 35
Railroad Accessories Corp. 40
Ramapo Ajax Corp. 49
Reed-Prentice Corp. 57
Reliance Manufacturing Company 2
Royal Blue Bed Spring Company 60

S

Sellers Manufacturing Company 69
Simmons-Boardman Publishing Company 63, 64, 66
Sullivan Machinery Company 61
Syntron Company 22

T

Timken Roller Bearing Company 26

U

U. S. Cast Iron Pipe & Foundry Company 45

V

Verona Tool Works 74

W

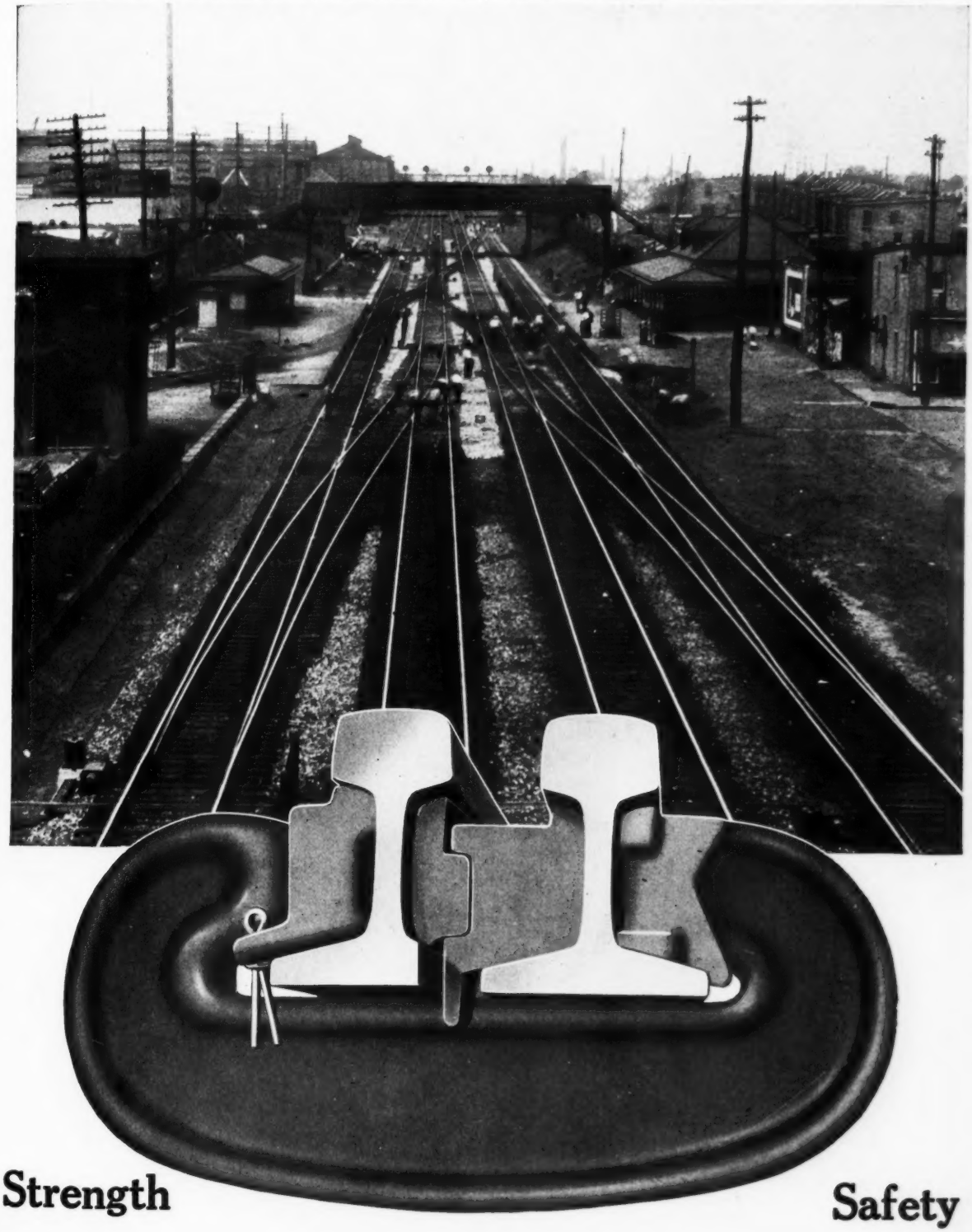
Western Wheeled Scraper Company 27
Wharton Jr., & Co., Wm. 61
Woodings Forge & Tool Company 57
Woolery Machine Company 42

THE Q & C UNIVERSAL GUARD RAIL CLAMP

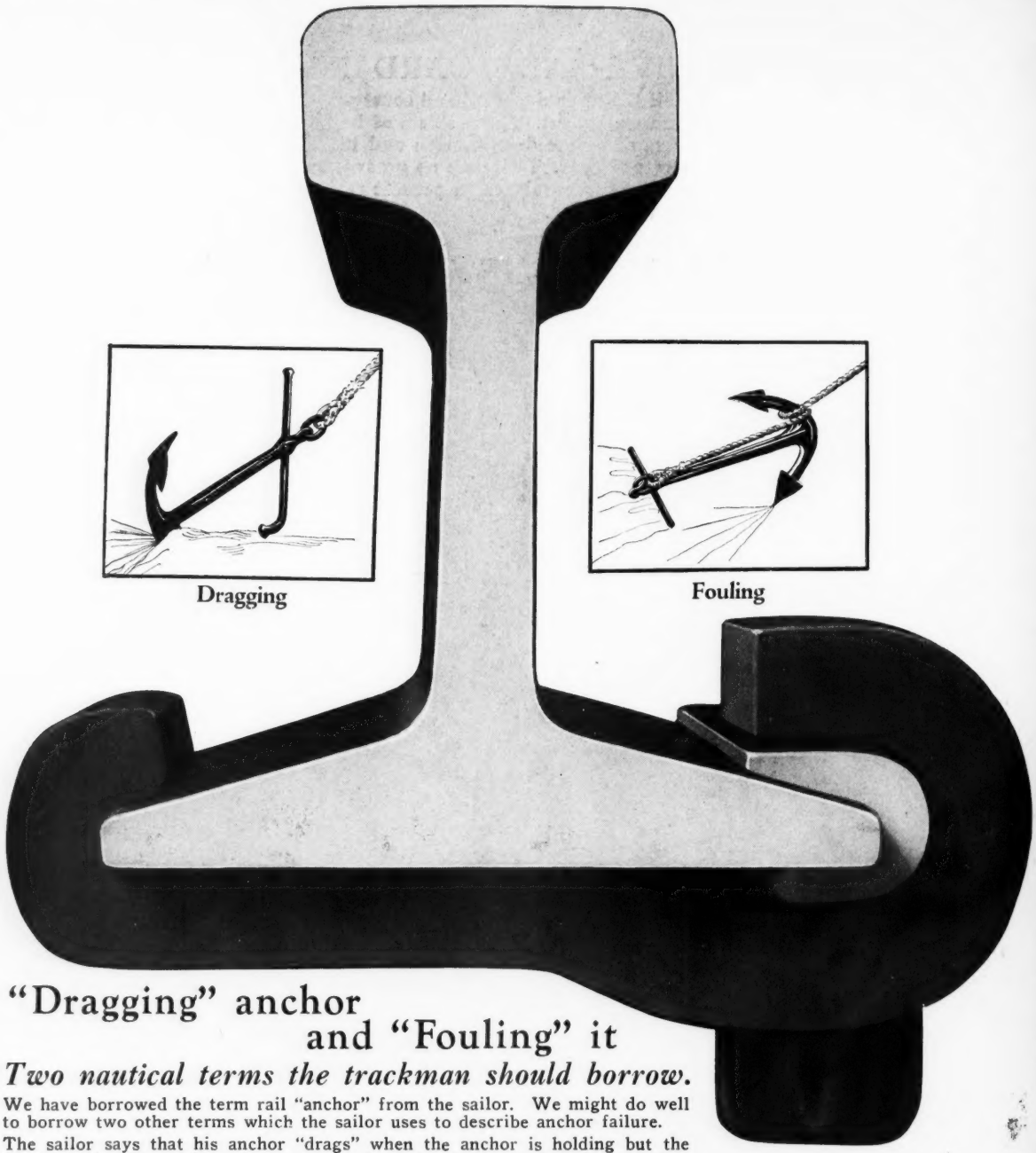
The Q & C Universal Guard Rail Clamp is designed and constructed to take care of the ever increasing weight and speed of modern equipment. The problem of holding heavier and higher guard rails in place is adequately taken care of by the deep section and high support of the extra heavy drop forged "I" beam yoke as illustrated below. There are no grooves or recesses in the yoke, giving it maximum strength throughout. The Universal design permits the use of the yoke on practically all rail sections by simply changing the fittings.

Our Engineering Department will be glad to forward blue prints and any other information desired.

THE Q & C COMPANY, 90 WEST ST., NEW YORK — CHICAGO — ST. LOUIS



Strength **Safety**



"Dragging" anchor and "Fouling" it

Two nautical terms the trackman should borrow.

We have borrowed the term rail "anchor" from the sailor. We might do well to borrow two other terms which the sailor uses to describe anchor failure.

The sailor says that his anchor "drags" when the anchor is holding but the bottom isn't. If the fluke of the anchor is buried in the mud, but the mud is too soft to keep the anchor from pulling through it, the sailor uses a second anchor of the same sort.

The sailor says that his anchor is "fouled" when the flukes are not buried in the "holding ground" or bottom. He takes it up and throws it out again. If the trouble is chronic, he gets a new anchor.

To borrow these terms: A rail anchor "drags" when it is keeping its position on the rail, but pushes the bearing tie through the ballast. If that occurs, there is nothing the matter with the anchor. More anchors on that rail will remedy the failure.

A rail anchor is "fouled" when through faulty application or faulty design it slips on the rail and thus allows creeping. If this condition cannot be overcome by re-application, the anchor should be discarded in favor of the Ericson Rail Anchor.

The distinction between dragging and fouling is of the utmost importance. Far too often a fouled anchor is supported by others of the same type, thus increasing the cost of maintenance and equipment. The only time it is justifiable to apply more than one anchor to a rail is when it is demonstrated that the failure is due to dragging—a failure, not of the anchor but of the ballast.

VERONA TOOL WORKS - - - PITTSBURGH